SEPTEMBER, 1933.

GENERAL PHYSICS.

ADSORPTION.

3870. Detection of Adsorbed Gas Films on Heated Filaments. G. van Praagh. *Chem. Soc., J. pp.* 798–800, *July,* 1933.—The thermal emissivity of a platinum filament is not affected by the presence of an adsorbed monatomic film of iodine. The accommodation coefficient of argon on the filament is increased by the presence of a film, and this method has been used to show that when the platinum is heated in iodine vapour at 0·027 mm. pressure, an adsorbed film is formed below 1565° K., but that above 1635° K. the platinum surface is bare. This result is in accordance with measurements of the kinetics of the attack of platinum by iodine vapour. AUTHOR.

3871. Chemisorption on Charcoal. Acid Constituent of Charcoal. A. King. *Chem. Soc., J. pp.* 842–846, *July,* 1933.—Ash-free charcoal exposed to air or O_2 and then extracted with water yields a crystalline residue. If the O_2 adsorbed is removed by heating *in vacuo* to 850° and replaced by N_2 before treatment with water, no extract is obtained. The amount formed is small, but with a given sample, after drying, the process can be repeated indefinitely; the yield is the same each time. The substance has been identified as oxalic acid. Other charcoals behaved similarly. It is assumed that a layer of an oxide of C is formed on its surface and that this is converted to oxalic acid by the action of water. A. S. C. L.

3872. Adsorption of Iodine by Potassium Iodide. B. Whipp. *Roy. Soc., Proc.* 141. *pp.* 217–232, *July* 3, 1933.—Adsorbed films of iodine on potassium iodide crystals are found to be two molecules thick at the saturation pressure. A kinetic explanation of the process is advanced on the assumption of a loosely bound second layer, and a two-constant isotherm is deduced which represents the adsorption up to saturation pressure. Evidence is presented showing that the surface molecules in the bimolecular film have properties similar to those in the surface of a crystal of pure iodine and the bearing of this on Volmer's theory of crystal growth is considered. Potassium tri-iodide is not formed as a separate phase. AUTHOR.

3873. Adsorption of Thorium-B and Thorium-C from Solution. Part I. J. F. King and A. Romer. *J. Phys. Chem.* 37. *pp.* 663–673, *June,* 1933.—The method of using ThB in a study of adsorption of ions on insoluble halide crystals is described in detail. Measurements are made by means of a β-ray electroscope, using an equilibrium mixture of ThB and ThC (isotopes respectively of Pb and Bi). The adsorption experiments are actually conducted on ThB ions, the amount thereof being determined by means of ThC. ThC is selectively adsorbed on glass in amount decreasing as the acidity of the solution increases, whilst that of ThB adsorbed is unaffected; this is perhaps due to their pseudocolloidal form. [See also Abstracts 2995 (1927) and 2156 (1932).] C. A. S.

3874. Inversion of Traube's Rule by Adsorption. B. Iliin. *Kolloid Zeits.* 64. *pp.* 99–101, *July,* 1933.—This paper is a reply to the article of Heymann and Boye [see Abstract 3957 (1932)]. The objections raised by Heymann and Boye are shown to be due to a misunderstanding. An attempt is also made to explain the observations made by these workers. J. K.

3875. Adsorbent Properties and Specific Surface of Lead Sulphate. I. M. Kolthoff and C. Rosenblum. *Am. Chem. Soc., J.* 55. *pp.* 2656–2664, *July,* 1933.—Determinations have been made of the solubility of $PbSO_4$ in water and in aqueous solutions of $Pb(NO_3)_2$ and of Na_2SO_4. The specific surface of $PbSO_4$ in water was determined by Paneth's radioactive indicator method. Complete equilibriation was not reached; this is attributed to slow interaction of molecules of $PbSO_4$ beneath the surface layer with the indicator. Adsorption of Pb ions is shown to cover less than 5 % of the specific surface. No Na_2SO_4 is adsorbed. The specific surfaces of two specimens were 4550 and 3580 cm^2. Values calculated from microscopic examination of the crystals were 3340 and 5800 $cm.^2$ (per gm.). A. S. C. L.

3876. Kinetics and Heat of Adsorption of Oxygen on Platinum. E. B. Maxted and N. J. Hassid. *Faraday Soc., Trans.* 29. *pp.* 698–702, *June,* 1933.—Constant heat values of about 60,000 cal./gm. mol of O_2, have been obtained for the adsorption of oxygen on platinum. Oxygen, unlike hydrogen [see Abstract 1773 (1932)], can be removed only by heating the platinum to a temperature sufficiently high to destroy the surface. After the main adsorption, the rate of which is logarithmic, there is a further slow reduction of pressure with time. A. S. C. L.

3877. Solvation of Molecules and the Equation of State of the Adsorption Layer. S. E. Bresler, J. B. Chariton, B. A. Talmud and D. L. Talmud. *Zeits. f. phys. Chem.* 165. *Abt.A.* 3. *pp.* 195–208, *July,* 1933.—Polar molecules which existed on the surface of water as an adsorption layer were dehydrated by the introduction of electrolytes and glycose into the water. The reaction was studied for cetyl alcohol and oleic acid. It was shown that the dehydration was associated with the alternating electrostatic action of polar groups in the adsorption layer. F. J. B.

See also Abstract 3954.

ATOMIC AND MOLECULAR STRUCTURE.

3878. Nature of the Chemical Bond. Part VI. Calculation from Thermochemical Data of the Energy of Resonance of Molecules Among Several Electronic Structures. L. Pauling and J. Sherman. *J. Chem. Phys.* 1. *pp.* 606–617, *Aug.,* 1933.—In the first part of this paper there is given a set of bond-energy values for single, double, and triple bonds between atoms, obtained from thermochemical data, such that the total energy of formation from separate atoms of a molecule containing given bonds is equal to the sum of the energies for those bonds. In the derivation of these values data were used only for molecules for which it is probable that one electronic structure, corresponding to one distribution of valence bonds, represents the normal state to a satisfactory degree of approximation. For other molecules more than one electronic structure of this type contributes essentially to the normal state, the energy of formation of the molecule then being larger than that for any one of the contributing structures. On comparing the energies of formation given by thermochemical data with the values calculated for various structures, it is verified that this difference is always positive or zero (to within the limits of error

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involved). The difference in energy is interpreted as the resonance energy of the molecule among several electronic structures, and its existence in a given case provides strong evidence that more than one structure is contributing to the normal state of the molecule, the number and importance of the contributing structures being indicated by the magnitude of the resonance energy. In this way the existence of resonance is shown for many molecules, and values found for the resonance energy are tabulated. The substances discussed include carbon dioxide, carbon disulphide, alkyl isocyanates, carboxylic acids and esters, aliphatic amines, carbonic esters, urea and related substances, benzene and benzene derivatives, napthalene and other condensed ring systems, pyridine and related heterocyclic compounds, biphenyl, fluorene, phenylethylene, dihydronaphthalene, quinone, some ureides and purines, etc. [For Part V see Abstract 3288 (1933).] AUTHORS.

3879. Free Radicals of Organic Chemistry. Quantum Theory of Aromatic and Unsaturated Compounds. Part IV. E. Hückel. *Zeits. f. Physik*, 83. 9–10. *pp*. 632–668, *July* 6, 1933.—The occurrence of free radicals possessing trivalent carbon and divalent nitrogen is bound up with the presence of aromatic and unsaturated substituents of these atoms. An explanation is proposed, *viz.*, that on dissociation of the compounds from which the radicals arise, the substituents pass over into a planar arrangement, for which the electronic processes at the double bonds are discussed. The latter involve an appreciable gain of energy, which accounts in large measure for the necessary work of dissociation. The conceptions of static and kinetic valency requirements are introduced, and the dependence of the static valency on the substituents is investigated for trivalent carbon. Finally, those influences are discussed which are determinative for the absolute position of the dissociation equilibrium. In solution, the change of phase volume of the solvent is found to be essentially connected with the dissociation. H. H. Ho.

3880. Structure of Liquid Mercury. O. Kratky. *Phys. Zeits*. 34. *pp*. 482–487, *June* 15, 1933.—An hexagonal packing suits the experimental facts best, but there remain difficulties. The theoretical curve has greater amplitudes than the experimental, and the two curves have different abscissæ. These discrepancies might be explained by the use of light not strictly monochromatic, and it is best to repeat the whole of the experiments with strictly monochromatic light, so as to eliminate all uncertainty. A general discussion of the relation between theory and experiment. A. D.

3881. Cybotactic View of the Interior of a Liquid. G. W. Stewart. *Indian Journ. Phys.* 7, *pp*. 603–615, *April* 20, 1933.—The cybotactic view regards a liquid as consisting of aggregates which crudely simulate crystalline orderliness and of molecules which are approximately at random. This view has already proved useful in giving a clearer insight into the nature of a solution of miscible liquids and into the effect of pressure in forming these liquid aggregates at temperatures and pressures above the critical values. Sixteen lines of experimental fact are cited, all of which without exception are in accord with the cybotactic view, while there are none in disaccord with it. A. D.

3882. Atomic Weight of Lead from Katanga Pitchblende. G. P. Baxter and C. M. Alter. *Am. Chem. Soc., J.* 55. *pp*. 2785–2792, *July*, 1933.—Katanga pitchblende, being almost free from thorium, should give pure uranium lead. The sample examined was black, veined with a softer yellow form. This was easily removed by solution in HCl, in which the black form is insoluble. The lead uranium ratio is higher for the yellow form. Mechanical separation followed by treatment with HCl left 77·2 % of the black form. The lead: uranium ratios were 0·089 (black) and 0·144 (yellow). The atomic weights of the leads were 205·996 (black) and 205·970 (yellow). These results are discussed and compared with values for other leads. A. S. C. L.

See also Abstracts 3935, 3937, 3938, 4036, 4048, 4093, 4138, 4166, 4204, 4205, 4238, 4259, 4265.

COLLOIDS.

3883. Ultrafiltration of Soap Solutions. J. W. McBain, Y. Kawakami and H. P. Lucas. *Am. Chem. Soc., J.* 55. *pp.* 2762–2769, *July,* 1933.—Hydration of colloidal soap can be found by ultrafiltration of solutions containing a reference substance which is neither retained by the filter nor adsorbed by the colloidal filtrate. The concentration of the reference substance is higher in the ultrafiltrate than in the original mixture of free and bound solvent. Adsorption of the reference substance gives reduced or even negative values. Using KCl, the hydration is about 12 molecules of water to each one of soap, for a normal solution of potassium laurate. Urea is adsorbed by the soap, but NaCl displaces it from sodium palmitate curd. Experiments at 90° gave a separation of molecularly and colloidally dissolved soap in quantitative agreement with less direct previous estimates. A. S. C. L.

3884. Electrical Conductivity of Capillary and Colloidal Systems. J. J. Bikerman. *Zeits. f. Elektrochem.* 39. *pp.* 526–531; *Disc.,* 531, *July,* 1933.—The large diameter and charge of a colloidal particle is shown to act so that the ions formed at any instant are practically within only a single attraction sphere, in contrast to the phenomena observed in true solutions. To this circumstance the strong mutual hindrance of colloids and ions in the electric field has been ascribed. If the mobility of an ion in a concentrated salt solution is, for example, 0·5 of its limiting mobility as a free ion, then the mobility of a colloidal ion can be 0·05 of this value. Accordingly, dispersion and field-strength effects are more readily established for colloids. Whilst in electrolytic theory the ion can be regarded as a point charge, the colloidal ion must have its material nature taken into account and especially its electrical conductivity. Practically all sols are highly concentrated in the sense of electrolytic theory, and further they are solutions of mixed electrolytes. An important test for colloidal ions is the ease with which their charge alters. The surface conductivity depends on the boundary layer charge. H. H. Ho.

3885. Electroosmosis and Anomalous Osmosis. D. R. Briggs. *Nat. Acad. Sci., Proc.* 19. *pp.* 704–710, *July,* 1933.—Measurements of the osmotic pressure of gum arabic, dialysed free from ions other than H, were made by placing a known amount in a collodion sac which was then immersed in an acid solution of NaCl. Pressure was applied to the interior against which diffusion of ions occurred until equilibrium was attained. The electroosmotic pressure P_E is the difference between P_o the observed osmotic pressure and P_c that calculated from the difference in osmotic concentrations at equilibrium. The sac was weighed. Since the volumes of liquid were known, its final distribution was thus also known. H-ion concentrations were measured for the liquid on each side of the membrane from which the membrane potential E was found; also the distribution of ions, from which P_e is found. The nature of the sac did not affect the results, so it is assumed that the effective membrane is a layer of gum arabic. The ζ potential, which is here that of membrane pore/flowing liquid, is for gum arabic. From the equation $P = 2E\zeta D/\pi r^2$ (where r is the pore radius), or $E\zeta/P_e$ = constant, and regarding ζ as a function of the fraction α of the colloid ionised, then $E\alpha/P_e$ would be a constant. This occurred only when the Cl content was constant; and with increase of concentration of foreign ion, $E\alpha/P_e$ became smaller. ζ seems to vary in a regular manner with the content of added ion. Experiments with the Ca salt in $CaCl_2$ indicate a reversal of sign of the ζ potential. A. S. C. L.

3886. Cataphoresis. Part III. Comparison of the Results of Measurements by the Transport and Moving Boundary Methods, and a Theory of the Latter Method. D. C. Henry and J. Brittain. *Faraday Soc., Trans.* 29. *pp.* 798–815, *July,* 1933.—A comparison is made, using a silver sol prepared by a modified Kohlschütter method, of the experimental results of the transport and the moving boundary methods of measuring cataphoretic mobility of a colloidal micelle. A critical examination indicates that the transport method, suitably applied, leads to values correct within experimental error, but that the results of the moving boundary method, as usually interpreted, are incorrect. The latter can, however, be correctly interpreted on the basis of the Kohlrausch-Weber theory of ionic displacements. The important influence of the nature and concentration of the supernatant liquid is established. N. M. B.

3887. Electrophoretic Behaviour of Lecithin and Certain Fats. C. W. Price and W. C. M. Lewis. *Faraday Soc., Trans.* 29. *pp.* 775–787, *July,* 1933.—The dissociation constant of chaline was determined and found to be 5·06. The isoelectric point of lecithin, from approximate values of its dissociation constant, was calculated to be at pH = 5·2. The electrophoretic behaviour of lecithin was studied and the point of reversal of charge corresponded to the value of the isoelectric point, found by previous workers, *viz.*, pH = 2·7. The electrophoretic behaviour of aqueous dispersions of $\alpha\alpha'$ dipalmitin, β azelao-$\alpha\alpha'$ distearin was also studied. F. J. B.

3888. Double Refraction in Streaming Solutions of Molecular Colloids. R. Signer and H. Gross. *Zeits. f. phys. Chem.* 165. *Abt. A.* 3. *pp.* 161–187, *July,* 1933.—A method of measuring the double refraction of very dilute solutions of highly polymerised substances while flowing was developed, and is described. One method was applied to solutions of polystyrols and nitrocelluloses. The results are compared with molecular data obtained from viscosity measurements, and the theory is discussed. F. J. B.

3889. Fluidities of Thixotropic Gels: Bentonite Suspensions. H. A. Ambrose and A. G. Loomis. *Physics,* 4. *pp.* 265–273, *Aug.,* 1933. —Flow measurements on bentonite suspensions, showing both the property of thixotropy and of fluidity variable with shearing stress, were performed in capillary tubes, brass pipes, and a rotary consistometer of special design. The latter instrument was used to show that the structure of such gels must be broken down or built up until an equilibrium state of flow is attained to obtain reproducible measurements. No slippage at the walls was found in non-plug flow. Turbulent flow of bentonite suspensions was investigated in ½-in. and 1-in. pipes. It is demonstrated that these materials behave as any viscous liquid, in the turbulent region, and that the volume of flow at any pressure gradient may be assumed to be the same as for water, without great error. The importance of obtaining equilibrium flow conditions for fluidity measurements is stressed. AUTHORS.

3890. Periodic Precipitation. R. Fricke. *Zeits. f. Elektrochem.* 39. *pp.* 629–641; *Disc.,* 641. *July,* 1933.—The periodic or Liesegang precipitations of $Ba(NO_3)_2$ contained in a narrow tube when HNO_3 diffuses through it are observed. After a chosen interval of interdiffusion, the tube is cut into small lengths, whose contents are carefully analysed and deductions made with the aid of specially prepared solubility data. The concentration of $Ba(NO_3)_2$ tends to rise, attaining supersaturation, and finally depositing a crystal at a point determined by the condition of the wall among other factors. The deposition generally occurs a little beyond the position of maximum supersaturation. The precipitation leaves further up the tube a smaller maximum of concentration, which subsequently grows, and produces a second precipitation. The results are in accord with the ordinary laws of diffusion and precipitation. J. P. A.

3891. High-Speed Centrifuge. W. D. Garman. *Rev. Sci. Instruments,* 4. *pp.* 450–453, *Aug.,* 1933.—An attempt is described to improve the mechanical details of the high-speed impulse centrifuge. A. S. C. L.

CRYSTAL STRUCTURE AND PROPERTIES.

3892. Topology of Parallelepiped Lattices. H. Heesch. *Zeits. f. Krist.* 85. *pp.* 335–344, *June,* 1933.—Combinatory geometrical analysis for cubical arrays, introduced by the analogous (and easier) case of squares. The two fundamentals upon which the spacial distribution is built are the principles of symmetry and co-ordination. F. I. G. R.

3893. "Correct Setting" of Crystals. G. Greenwood. *Zeits. f. Krist.* 85. *pp.* 420–424, *June,* 1933. *In English.*—The arbitrary nature of the usual axial systems of reference is stressed, and an attempt is made to provide a more natural scheme. The most symmetrical unit cell in the X-ray structure is taken as the basis, and its edges are taken as the appropriate axial directions. A study is included of the structure of methyl ammonium chlorocuprate $[NH_3\,CH_3]_2\,CuCl_4$ and of dimethyl ammonium chlorostannate $[NH_2\,(CH_3)_2]_2\,SnCl_4$. The former has four molecules in the unit cell, and the latter two. The settings agree with v. Federow rather than with Mallard. F. I. G. R.

3894. Determinations of the Signs of the Fourier Terms in Complete Crystal Structure Analysis. K. Banerjee. *Roy. Soc., Proc.* 141. *pp.* 188–193, *July* 3, 1933.—An extension of the methods of Bragg and Ott. The latter is not altogether convenient for complicated crystals: the signs of the terms can be determined, however, and the scheme is applied to anthracene, for which the intensities are well known. F. I. G. R.

3895. Structure of Magnesium, Zinc and Aluminium Films. G. I. Finch and A. G. Quarrell. *Roy. Soc., Proc.* 141. *pp.* 398–414, *Aug.* 1, 1933.—An electron diffraction camera is described in which the specimen is swept by a diffuse beam of electrons, thereby reducing the risk of injury to the specimen. The beam is subsequently focussed electromagnetically. Examination has been made of oxide-free surfaces of Mg, Zn and Al on a Pt substrate : of vapours of these metals in transit between source and receiver, and of the oxides of Mg and Zn formed on the corresponding metal surfaces. The results show (1) that abnormal crystal structures are due to pseudomorphic strain effects, the substrate influencing the positions taken up by the atoms of the metal or metal oxide layers, (2) that such effects are no longer evident at the surface of sufficiently thick films, and (3) that Mg, Zn and Al vapours are monatomic. F. C. C.

3896. Catalytic Properties and Structure of Metal Films. Part I. Sputtered Platinum. G. I. Finch, C. A. Murison, N. Stuart and G. P. Thomson. *Roy. Soc., Proc.* 141. *pp.* 414–434, *Aug.* 1, 1933.—Films of Pt on glass and quartz were prepared by sputtering in an atmosphere of O_2, N_2, A, or H_2, and their catalytic properties and method of preparation correlated with the structure found by electron diffraction. Films formed in O_2 showed fuzzy PtO_2 rings on a general background and the catalytic activity seemed connected with the extent of the background ; the latter may be caused by the presence of single atoms or other non-crystalline bodies. The PtO_2 films are difficult to move mechanically and never show orientation ; on the other hand, films of Pt obtained by sputtering in A are easily removed mechanically and show orientation readily. It was not found possible to test the film by diffraction in the act of catalysis. [See also Abstract 2696 (1933).] F. C. C.

3897. Crystal Structure of Ammonium Hydrogen Fluoride, NH_4HF_2. L. Pauling. *Zeits. f. Krist.* 85. *pp.* 380–391, *June,* 1933. *In English.*—The unit of structure of the orthorhombic crystal NH_4HF_2, containing four molecules, has $a=8\cdot33$ Å, $b=8\cdot14$ Å, $c=3\cdot68$ Å, space group V^7_h—P*man*. The atomic positions are :

$$\begin{array}{lll} 4\,\mathrm{N}\ \text{in}\ 4g: & \pm\,(\tfrac{1}{4}\,\tfrac{1}{4}\,z,\ \tfrac{3}{4}\,\tfrac{1}{4}\,z) & z=0\cdot560\pm0\cdot010\,; \\ 4\,\mathrm{F}_1\ \text{in}\ 4e: & \pm\,(w\,0\,0,\ \tfrac{1}{2}+w\,\tfrac{1}{2}\,0) & w=0\cdot142\pm0\cdot005\,; \\ 4\,\mathrm{F}_2\ \text{in}\ 4h: & \pm\,(\tfrac{1}{2}\,u\,v,\ 0\,\tfrac{1}{2}-u\,v) & u=0\cdot132\pm0\cdot005, \\ & & v=0\cdot135\pm0\cdot010. \end{array}$$

Each nitrogen is attached to four fluorine ions at a distance of $2\cdot76$ Å by hydrogen bonds, and each fluorine ion to two nitrogen and one fluorine ion, the F—H distance in the linear HF_2 groups being $1\cdot184$ Å. AUTHOR.

3898. X-Ray and Electron Diffraction of Iodine and the Diiodobenzenes. S. B. Hendricks, L. R. Maxwell, V. L. Mosley and M. E. Jefferson. *J. Chem. Phys.* 1. *pp.* 549–565, *Aug.*, 1933.—The crystal structures of 1,3 and 1,4 diiodobenzene were determined from the X-ray diffraction patterns of single crystals. The separations of the iodine atoms in the molecules were found to be $6\cdot85$ and $5\cdot92$ Å, respectively. These values are in agreement with results obtained by analysis of the electron diffraction patterns given by the vapours of these compounds. The most satisfactory explanation of the electron diffraction results for 1,2 diiodobenzene requires the I—C valence directions to be bent by about 10° from symmetrical positions in the plane of the benzene ring. In this molecule the I—I distance was found to be $4\cdot00$ Å, which is approximately the same as the minimum intermolecular iodine distances in crystals of the other isomeric diiodobenzenes. Electron diffraction was obtained from vapours of CCl_4 and iodine. The separation of the iodine atoms in the latter molecule was found to be 2·64 Å, a value in agreement with band spectra data and with previous crystal structure analysis. AUTHORS.

3899. Crystallography of Compounds of Gadolinium and Samarium. A. Pabst. *Am. J. Sci.* 26. *pp.* 72–79, *July,* 1933.—The following compounds of gadolinium were examined optically: formate, acetate, propionate, butyrate, bromate; also samarium bromate. The indices of refraction are given for several wave-lengths, and the optical signs (in above order) are −, +, −, +, −, −. F. I. G. R.

See also Abstracts 3905, 3906, 3907, 3908, 3909, 3910, 3927, 3951, 4082, 4141, 4148, 4227, 4266, 4269.

DENSITY.

See Abstracts 3951, 4156.

DIFFUSION AND OSMOSIS.

See Abstracts 3885, 3890, 3940, 4227.

ELASTICITY AND PLASTICITY.

3900. Equilibrium of an Elastic Circular Plate. H. Ôkubo. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 175–180, *April,* 1933. *In English.*—An elastic circular plate is compressed radially by a number of equal forces distributed evenly round the circumference. Taking the general expression due to S. Yokota for stress components of two-dimensional systems, the state of stress is analysed. J. P. A.

3901. Biharmonic Analysis in a Perforated Strip. R. C. J. Howland and A. C. Stevenson. *Roy. Soc., Phil. Trans.* 232. *pp.* 155–222, *June* 2, 1933.—Previous work [see Abstract 2072 (1930)] is generalised to include unsymmetrical solutions of the biharmonic equation for a strip bounded externally by two parallel straight lines and internally by a circle; and the formulæ are developed to deal with any problem of stress distribution within these boundaries. The problems of pure bending, and of bending together with shear, are worked out in detail. Among the chief results are the following: (1) When a tension is applied to the strip there appears at the edge of the hole a tension which is always greater than three times the tension at infinity. Near the edge of the strip, at the mid-section, the tension decreases as the size of the hole increases. (2) When a bending moment is applied the tension at the rim of the hole is always about twice as great as it would be if the hole were absent. (3) Failure is most probable at the edge of the hole. The analysis can be adapted readily to the study of the motion of a cylinder in a viscous liquid. J. P. A.

3902. Permanent Stability. H. Juretzek and F. Sauerwald. *Zeits. f. Physik,* 83. 7–8. *pp.* 483–491, *June* 28, 1933.—A discussion of the ascertainment of permanent stability from the curve of velocity of extension in dependence on the load. The subject is dealt with in relation to the stability of materials used in construction and industry, and reference is made to the arbitrary constants used in testing materials. J. J. S.

3903. Deflection of a Cantilever Bar Rotated under End Load. W. Hunter. *Cambridge Phil. Soc., Proc.* 29. *pp.* 423–439, *July* 30, 1933.—A uniform bar is clamped at one end and loaded at the other, and is then rotated about its axis at the clamp. The stresses introduced by the rotation are investigated analytically, and it is found that the problem may be reduced to that of the combination of forced flexural vibrations in two perpendicular directions. An attempt is made to take into account the damping effect of internal friction. The resulting formulæ for the deflections are compared with experimental results of other investigators, and it is noted that the observations of Kimball and Lovell [see Abstract 2442 (1927)] do not appear to agree with the present results. J. P. A.

3904. Measurement of Poisson's Ratio. W. A. Zisman. *Rev. Sci. Instruments,* 4. *pp.* 342–344, *June,* 1933.—A simple arrangement is described for measuring lateral contractions of the order 10^{-7} cm. upon a cylindrical specimen. Particular attention is given to the stability of the apparatus when in use. **Errata,** *ibid. p.* 507, *Sept.,* 1933. J. P. A.

3905. Temperature Dependence of Young's Modulus for Nickel. J. Zacharias. *Phys. Rev.* 44. *pp.* 116–122, *July* 15, 1933.—A new method is described for the measurement of Young's modulus and its variation with temperature below 400° C. The method is applied to single crystals of pure nickel and to hard drawn, polycrystalline, commercial nickel between 30° C. and 400° C. The variation of Young's modulus with temperature in these substances depends on the previous thermal history of the sample. Between 30° and 200° Young's modulus for annealed specimens decreases about 13 %. This is followed by an increase to the Curie point of about 6 % and above the Curie point by a linear decrease. For hard drawn specimens and specimens quenched at 1100° the minimum is wholly absent. Young's modulus decreases continuously to the Curie point, where the temperature coefficient changes abruptly. AUTHOR.

3906. Tensile Strength of Rock-Salt. K. Honda and R. Kimura. *Tohoku Univ., Sci. Reports,* 22. *pp.* 375–379, *May,* 1933. *Report No.* 303 *from The Research Inst. for Iron, Steel, and other Metals. In English.*—The theoretical value of the tensile strength of rock-salt is very large as compared to the value experimentally obtained. The discrepancy is explained by the fact that the condition assumed in the theoretical calculation, that is, the uniform elongation of the lattice distance by tension, is not fulfilled in the actual stretching. AUTHORS.

3907. Tensile Strength of Crystals. A. Smekal. *Zeits. f. Physik,* 83. 5–6. *pp.* 313–316, *June* 20, 1933.—Theoretical prediction that the tensile strength of crystals should be diminished by the addition of impurity, is contrasted with experimental result, which generally shows an increase in the tensile strength. Experiments, however, deal almost exclusively with crystals in the plastic state, whereas theory applies to ideal, non-plastic materials. Interpretation of experiments should take account of this distinction. J. P. A.

3908. Influence of Impurity on the Tensile Strength of Rock-Salt. W. Burgsmüller. *Zeits. f. Physik,* 83. 5–6. *pp.* 317–320, *June* 20, 1933.—The tensile strength is found at temperatures 20°, − 70°, − 190°, and − 252° C., for pure rock-salt crystals, and for crystals containing measured small percentages of strontium chloride. At room-temperatures, the addition of 0·045 % $SrCl_2$ increases the tensile strength to 1000 gm/mm.² as compared with 213 gm/mm.² for the pure crystal. At − 70° C. the increase is much less, while at − 190° and − 252° C., the same percentage of impurity diminishes the strength from 560 gm/mm.² to 135 gm/mm.² Interpolation indicates that at about − 110° C. the $SrCl_2$ would have no influence. J. P. A.

3909. Tensile Strength of Rock-Salt at 1·2° Abs. K. Steiner and W. Burgsmüller. *Zeits. f. Physik*, 83. 5–6. *pp.* 321–322, *June* 20, 1933.—The tensile strength of a rock-salt crystal in liquid helium is, within the limits of experimental error, the same as in liquid hydrogen. Apparatus employed is the same as in previous work [see preceding Abstract]. J. P. A.

3910. Plasticity and Mechanical Twinning in Quartz. K. Zinserling and A. Schubnikow. *Zeits. f. Krist.* 85. *pp.* 454–461, *June*, 1933.—The twinning of quartz under the pressure of a steel ball is further discussed [see Abstract 4783 (1932)]. An experiment is described in which the stress just producing yield in the quartz is found at about 573° C. Its value is about one-fifteenth the yielding stress at room-temperatures. J. P. A.

3911. Viscosity, Elasticity and Plastic Strength of Soft Materials (Flour Dough). Part III. R. K. Schofield and G. W. S. Blair. *Roy. Soc., Proc.* 141. *pp.* 72–85, *July* 3, 1933.—A further study of the mechanical properties of flour dough has revealed the presence of two properties in addition to hardening, both of which are well known in the study of metals; namely, elastic after-effect and elastic hysteresis. The first necessitates the addition of a term $d\alpha/dt$ to the Maxwell equation, which then becomes

$$\frac{de}{dt}=\left(\frac{1}{n}\,\frac{dS}{dt}-\frac{d\alpha}{dt}\right)+\frac{1}{\eta}.\,S.$$

This term is only important when abrupt changes of stress have recently occurred. The second property causes n to decrease steadily whenever dS/dt preserves the same sign for some time, and to increase abruptly when the sign of dS/dt is changed. It was shown previously [see Abstract 2173 (1933)] that the viscosity, as determined from the rate of flow, agreed roughly, but not exactly, with that calculated as the product of the rigidity modulus and the relaxation time. It is now clear that the value adopted for n was a mean value, and differed somewhat from that appropriate to the conditions during stress relaxation. Due appreciation of this point renders the agreement quantitative. AUTHORS.

3912. Interference Fringes in Stress Analysis. M. M. Frocht. *Frank. Inst., J.* 216. *pp.* 73–89, *July*, 1933.—From measurements of lateral deformations in a loaded test-piece, the sum of the principal stresses P, Q may be determined from point to point. A simple interference arrangement is described for photographing lines in which P+Q is constant. Combined with observations of double refraction in a transparent model (from which P−Q is found) the state of stress may be completely determined. J. P. A.

3913. New Method of Deriving Stresses Graphically from Photoelastic Observations. H. Neuber. *Roy. Soc., Proc.* 141. *pp.* 314–324, *Aug.* 1, 1933.—The author gives a new method of deriving the two principal stresses from the isochromatics and isoclinics. This method enables us to trace the so-called "isopachic lines," along which the sum of the two principal stresses has an equal value. Since we can assign to each line its appropriate parameter we know in this way the sum of the principal stresses at any point of the plate. The method is based entirely upon elastic equations; therefore it is very accurate, offers several alternative methods of checking, and can be carried out in a very simple manner. Isopachics, isochromatics and isoclinics together give

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values and directions of the two principal stresses at any point, therefore they represent the complete field of stress. AUTHOR.

3914. Compressometer for Evaluating Thickness, Compressibility and Compressional Resilience of Textiles and Similar Materials. H. F. Schiefer. *Bureau of Standards, J. of Research,* 10. *pp.* 705–713, *June,* 1933.—The instrument provides a convenient means for measuring the thickness and the change in thickness of a textile or similar material when it is subjected to increasing or decreasing pressures. The foot of the instrument can be lowered or raised by means of a rack and pinion acting through a helical spring. The pressure applied to the specimen by the foot is indicated on a dial micrometer and the corresponding thickness of the specimen on a second dial micrometer. Readings are taken under increasing pressures and then under decreasing pressures. Curves for the compression and recovery of several materials are shown. Definitions are proposed for the terms thickness, compressibility, and compressional resilience as applied to textiles. The results of tests on rug underlays, blankets, felts, on knit, woven, and pile fabrics, and on sheet rubber and paper are given. AUTHOR.

See also Abstract 3960.

GRAVITATION.

3915. Observation of Gravity by Means of Invariable Pendulums. E. C. Bullard. *Roy. Soc., Proc.* 141. *pp.* 233–258, *July* 3, 1933.—A method of comparing the periods of pendulums swinging simultaneously at two stations is described. This does not require special wireless signals, and enables a relative determination of g to be made with an accuracy of 1/1,000,000 in two swings of one hour each. A method of comparing gravity pendulums and wireless time signals is also described. AUTHOR.

See also Abstracts 3944, 3945, 3995, 3996.

HYDRODYNAMICS AND AERODYNAMICS.

3916. Aerodynamics of an Arrow. G. J. Higgins. *Frank. Inst., J.* 216. *pp.* 91–101, *July,* 1933.—A mathematical treatment of the problem of the flight of an arrow leading to simplified formulæ by means of which it is possible to compute the effects of the different variables. It is found that the shooting angle is not very important, a variation of 10° from that giving the greatest range (43° to 44°) produces a loss of only about 4·5 % in range. Increase of weight produces increase of range up to a certain limit. Increase of initial velocity also increases the range. The average arrow of 300 grains weight has a maximum range of 652 ft. and a flight time of 6·87 sec. With an initial velocity of 180 ft. per sec. it has a terminal velocity of 127 ft./sec. and strikes the ground at an angle of 53°. J. W. T. W.

3917. Fall of a Strip of Paper. J. G. Baker. *Phil. Mag.* 16. *pp.* 175–178, *July,* 1933.—The fact that appreciable time is required for turbulent air to accumulate on the upper side of a falling piece of paper is a likely basis for an explanation of the spinning of such a strip of paper and of its failure to descend vertically in still air. A. D.

3918. Ellipsoidal Functions and their Application to Some Wave Problems. E. T. Hanson. *Roy. Soc., Phil. Trans.* 232. *pp.* 223–283, *June* 3, 1933.—Ellipsoidal functions are involved in the solution of some wave problems such as the scattering of waves by a thin circular disc and the passage of waves through a circular aperture in a thin screen.

The expansion of an arbitrary function in a series of ellipsoidal functions is obtained and also an expression suitable for the representation of a divergent wave. Rayleigh's solution for the scattering of plane waves, when the ratio of the diameter of the disc to the wave-length is small, is shown to be slightly in error. It is shown that for values of the above ratio somewhat greater than unity the expansion of the coefficients in ascending powers of the ratio is inadmissible, and a suitable expansion is obtained. Some problems of the oscillations of a gas in a rigid spheroidal envelope are briefly treated. G. G. S.

3919. Flow of Perfect Compressible Fluids. C. Jacob. *Comptes Rendus*, 197. *pp.* 125–126, *July* 10, 1933.—Values of the stream and potential functions and the resistance are derived for the case of a jet of gas incident upon an obstacle formed of two planes disposed symmetrically with respect to the jet. The analysis is extended to incompressible fluids. J. S. G. T.

3920. Total Dissemination of Fluid. D. Riabouchinsky. *Comptes Rendus*, 197. *pp.* 390–392, *July* 31, 1933.—The case of fluid motion previously discussed by Bouligand [see Abstract 2140 (1931)] is treated mathematically as a case of continuous expansion of the fluid. J. S. G. T.

3921. Turbulence Statistics in Burgers' Phase Space. W. Tollmien. *Physics*, 4. *pp.* 289–290, *Aug.*, 1933.—The author's extension of Burgers' theory of turbulent flow, in which a phase space is postulated satisfying the analogy of Liouville's theorem of classical statistical mechanics is briefly reviewed. The author's purpose is to derive exact solutions rather than the approximations obtained by Burgers. J. S. G. T.

3922. Origin of Turbulence in the Case of Laminar Flow. H. Schlichting. *Göttingen Nachrichten, Math-Phys. Klasse*, 2. *pp.* 181–208, 1933.—A theory of the incidence of turbulence in laminar fluid motion is developed by the extension of the theory of small oscillations due to Tollmien. J. S. G. T.

3923. Mechanical Similarity in the Regular Motions of Viscous Fluids. M. Lelli. *Accad. Lincei, Atti*, 17. *pp.* 718–724, *May* 7, 1933.—One modern method of investigation consists in constructing a model of the mechanical system to be studied. The laws of similarity between the system to be studied and its model are here considered in the case of the motion of a viscous fluid. A. J. McC.

3924. Investigation of [Liquid] Flow in a Rotating Laboratory. H. Fette. *Zeits. f. techn. Physik*, 14. 7. *pp.* 257–266, 1933.—The velocity distribution in water flowing in a straight or circular channel arranged in a rotating vessel in a chamber containing the observer and rotating with the vessel is investigated experimentally and theoretically. The pressure distribution on a sphere immersed in the stream is also investigated. Satisfactory agreement is found between experimental and theoretical results. J. S. G. T.

See also Abstracts 4000, 4004, 4015, 4016.

KINETIC THEORY OF MATTER.

3925. Influence of Heat Flow on the Brownian Movement. Part II. M. Satô. *Zeits. f. Physik*, 83. 5–6. *pp.* 412–416, *June* 20, 1933. —In a former paper [see Abstract 2197 (1933)] the author has considered the effect of heat flow on the Brownian movement, the molecular impact on the particle being considered to be that of a completely elastic reflection. The present paper is a mathematical note on the effect of condensation and re-evaporation of the gas molecules. Here both rotation and translation have to be considered. T. B.

3926. Theory of Brownian Motion and Operational Method. J. Métadier. *Comptes Rendus*, 197. *pp.* 29–31, *July* 3, 1933.—The operational method previously described [see Abstract 1491 (1932)] is shown to be equivalent to the classical method, but is more advantageous in problems involving a diffusion equation. [See also Abstract 77 (1933).] C. A. S.

See also Abstracts 3940, 4287.

MATHEMATICAL METHODS. THEORY OF MEASUREMENTS. UNITS AND DIMENSIONS.

3927. Four-Place Table of sinx/x. J. Sherman. *Zeits. f. Krist.* 85. *pp.* 404–419, *June*, 1933. *In English.*—The intensities of waves diffracted by gas molecules with random orientation may be expressed by a formula of the following type: $I = \sum_i f_i \frac{\sin a_i x}{a_i x}$ in which the a's are constants and x is proportional to the sine of half the scattering angle. The procedure which is employed for determining the structure of a single molecule by electron and X-ray diffraction experiments in the gas consists of calculating intensity curves for as many molecular models as are compatible with the known properties of the compound and then of comparing the various calculated intensity curves with the photographs, the model affording the best correlation being considered as the most probable. This procedure involves considerable calculation and is facilitated by the present table. AUTHOR.

3928. Fermat's Principle. L. Natanson. *Phil. Mag.* 16. *pp.* 178–192, *July*, 1933.—A very interesting mathematical disquisition, in which an interlacing network of general relations is deduced from first principles. These general mathematical relations are then applied to particular cases in physics, and it is shown how an array of physical theorems, including Fermat's Principle, are directly derivable from them. A. D.

See also Abstracts 3918, 4123.

MECHANICS, CLASSICAL.

3929. Curves of Constant Pressure. M. Haimovici. *Accad. Lincei, Atti*, 17. *pp.* 633–636, *April* 23, 1933.—Studies curves upon a surface such that for a material point moving along one of them without friction under the action of a conservative field of force, the particle may exert upon the curve a constant pressure. A. D.

3930. Geodesic Curvature of the Dynamical Trajectories of Holonomic Systems. E. Gugino. *Accad. Lincei, Atti*, 17. *pp.* 714–718, *May* 7, 1933.—The configurations of a dynamical system of n degrees of freedom are represented geometrically by the points of a Riemannian space of n dimensions, and its motion under a given force system is represented by a curve in this space. A formula, exactly analogous to the well-known result for a particle moving in ordinary space, is established between the force vector, the principal normal and the geodesic curvature of the dynamical trajectory. A. J. McC.

3931. Oscillations of Frictionally-Coupled Oscillatory Systems. E. Hahnkamm. *Zeits. f. angew. Math. u. Mechanik*, 13. *pp.* 183–202, *June*, 1933.—For two frictionally-coupled oscillatory systems there is a certain value of the coupling-coefficient for which the absolute maximum of the resonance-function of the first oscillatory system (the one whose oscillations are to be damped) assumes a minimum value. An expression is given for the coupling-factor, which can be found experimentally. The two systems are to be put thoroughly out of tune with one another. A. D.

MECHANICS, QUANTUM.

3932. Extension to Wave-Mechanical Theory. R. Zaycoff. *Zeits. f. Physik*, 83. 5–6. *pp.* 338–340, *June* 20, 1933.—An entirely mathematical paper concerned with a method of taking account of the difference between negative and positive electrons. J. E. R. C.

3933. Boundary Conditions for the Wave Equation. W. H. McCrea and R. A. Newing. *Roy. Soc., Proc.* 141. *pp.* 216–217, *July*, 1933.—The theory covers the important cases in wave-mechanics, and in particular it shows that Wilson's equation [see Abstract 1835 (1928)] must possess eigensolutions of the usual kind. AUTHORS.

3934. Magnetic Interaction of a Valence Electron with Inner Shells. M. H. Johnson, Jr., and G. Breit. *Phys. Rev.* 44. *pp.* 77–83, *July* 15, 1933.—The magnetic interaction terms between two electrons are well known. By using antisymmetric wave functions the diagonal terms of the energy matrix for this interaction are calculated for an electronic configuration consisting of a valence electron and a closed shell. From the diagonal elements the doublet separation is easily obtained by applying the energy sum rule. The direct integrals, that is, terms which would occur even though the wave functions were not symmetrised for the Pauli principle, yield the expected contribution to the doublet separation; namely the interaction of the spin of the valence electron with the electric field produced by the closed shell. The exchange integrals give a contribution which decreases the doublet separation in the cases examined. They have been evaluated for the *f* terms of CsI. Their effect is much too small to explain the inversion of the doublets in this spectrum. AUTHORS.

3935. Normal State of the Hydrogen Molecule. S. Weinbaum. *J. Chem. Phys.* 1. *pp.* 593–596, *Aug.*, 1933.—A simple wave function for the normal state of the hydrogen molecule, in which both the atomic and ionic configurations are taken into account, was set up and treated by a variational method. The dissociation energy was found to be 4·00 eV as compared to the experimental value of 4·68 eV, and Rosen's value of 4·02 eV obtained by use of a function involving complicated integrals. It was found that the atomic function occurs with a coefficient 3·9 times that of the ionic function. A similar function with different screening constants for the atomic and ionic parts was also tried. It was found that the best results are obtained when these screening constants are equal. The addition of Rosen's term to the atomic-ionic function resulted in a value of 4·10 eV for the dissociation energy. AUTHOR.

3936. Calculations of Atomic Wave Functions. Part I. Survey and Self-Consistent Fields for Cl^- and Cu^+. D. R. Hartree. *Roy. Soc., Proc.* 141. *pp.* 282–301, *Aug.* 1, 1933.—Approximate wave functions for a number of atoms have been calculated by the method of the self-consistent field, but of the available results few have been published in detail. These results for a number of atoms are being revised, and the approximation improved, with a view to publication so as to make them more generally accessible ; this paper presents the results for Cl^- and Cu^+. The results for copper are compared with those for the other alkali metals and characteristic differences noted ; and the relation between the inter-atomic distance in metals and the wave function of the series electron is pointed out. AUTHOR.

3937. Charge Distributions in Fluorine and Neon. F. W. Brown. *Phys. Rev.* 44. *pp.* 214–223, *Aug.* 1, 1933.—Hartree fields (modified to take account of exchange between 2*p* electrons) have been obtained for F, F^-, Ne. The energy parameters of the 1*s*, 2*s* and 2*p* electrons are found to be 53·08, 2·40 and 1·09 for F ; 52·38, 1·50 and 0·14 for F^- ; and 65·68, 2·75, and 1·51 for Me. The use of the fields for F and F^- enable one to test the wave equation of the " hole " given by Heisenberg and Dirac. This equation is found to be equivalent to the Hartree equation for the corresponding electron and to give the wrong sign for the electron affinity of F. The 1*s*, 2*s* and 2*p* functions have been represented by analytic expressions of the Slater type. AUTHOR.

3938. Has the Negative Energy Spectrum an Influence on Nucleus Phenomena? G. Beck. *Zeits. f. Physik,* 83. 7–8. *pp.* 498–511, *June* 28, 1933.—The question is discussed how far Dirac's theory of " holes " appears fitted (qualitatively in the first place) to give an account of a series of phenomena of the nucleus. J. J. S.

3939. New Presentation and Interpretation of the Quantum Equations. H. T. Flint. *Roy. Soc., Proc.* 141. *pp.* 363–375, *Aug.* 1, 1933.—The union of Dirac's equations with the theory of relativity is discussed by the use of Einstein's theory of parallelism. The relation of the present work to that of Schrödinger is shown and some difficulties in Schrödinger's theory are avoided. A feature of this paper is the natural introduction of a relation between the Riemannian curvature and quantities characteristic of the quantum theory—a feature which the paper has in common with the work of Schrödinger. AUTHOR.

3940. Free Paths and Transport Phenomena in Gases and the Quantum Theory of Collisions. Part I. Rigid Sphere Model. H. S. W. Massey and C. B. O. Mohr. *Roy. Soc., Proc.* 141. *pp.* 434–453, *Aug.* 1, 1933.—The quantum theory of collisions is applied to the motion of gas atoms. Using the rigid sphere model, the range of validity of the classical theory of free paths, viscosity and diffusion is determined. The use of quantum mechanics greatly improves the applicability of this model to the viscosity of helium. The scattering of atoms is considered in detail, and the possibility of experimental proof of the Bose-Einstein statistics is discussed. F. C. C.

3941. Statistics of Diatomic Gases. K. Széll. *Zeits. f. Physik,* 84. 1–2. *pp.* 112–118, *July* 17, 1933.—The Fermi-Dirac or Bose-Einstein statistical theory is applied to discuss the rotatory motion of diatomic gases composed of rigid molecules. Results relating to degeneration derived fron the theory agree with those deduced from results relating to the specific heat of rotation of hydrogen molecules. J. S. G. T.

3942. Statistical Theory of Low-Frequency Intermolecular Forces. J. G. Kirkwood. *J. Chem. Phys.* 1. *pp.* 597–605, *Aug.*, 1933.—The sum of states of a gas consisting of optically anisotropic polar molecules is shown to be substantially equal to the classical Gibbs phase integral at ordinary temperatures. A general method of obtaining the quantum correction to be applied at low temperatures is developed. The intermolecular potential energy appearing in the phase integral is semi-classical in form. The low-frequency contribution arising from the permanent dipole moments of the molecules is exactly equal to their mutual electrostatic energy. The high-frequency contribution is given by a modification of London's formula in which continuous functions of the molecular orientations occur instead of spatial quantum numbers. AUTHOR.

See also Abstracts 4041, 4166, 4250, 4265.

RELATIVITY AND ETHER.

3943. Theory of Secular Aberration. Y. Hagihara. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 155–174, *April*, 1933. *In English.*—A discussion of the theory of aberration from the point of view of special relativity. No " ether drag " effect emerges from this study. G. C. McV.

3944. Class of Solutions of Einstein's Gravitational Equations. C. Racine. *Comptes Rendus,* 197. *pp.* 302–304, *July* 24, 1933.—The limitation of finding solutions of Einstein's gravitational equation in Riemannian space subject to seven conditions is discussed. J. S. G. T.

3945. Theory of Gravitation and Electromagnetism. H. P. Soh. *J. Math. Phys.* 12. *pp.* 298–305, *May,* 1933.—Einstein's successful generalisation of the gravitational field led at once to the hope that similar purely geometrical ideas might also serve completely to describe the phenomena of the electromagnetic field as embodied in the classical Maxwell-Lorentz equations and Lorentz's law of force on a charged particle. This idea led Weyl and Eddington, and more recently Einstein himself, to suggest modifications of Riemannian geometry so as to make room for the electromagnetic field. None of these theories has proved quite satisfactory. Two masses which are of the same sign attract one another ; two charges of the same sign repel one another. This can be formally brought out if we associate the factor $\sqrt{-1}$ with the electric charge. With this idea in mind the author has studied a complex Riemannian line element, in which the real part is associated with mass (gravitation) and the imaginary part with charge (electromagnetism). The theory thus obtained is remarkably simple ; the Maxwell equations and the Lorentz law of force both come out in the first approximation as a result of a fundamental identity in Riemannian geometry. Further, the connection between charge and current densities and the electromagnetic potential becomes at once clear. The author works out his suggested theory. A. D.

3946. General Field Theory : Semi-Vectors and Spin Space. J. A. Schouten. *Zeits. f. Physik,* 84. 1–2. *pp.* 92–111, *July* 17, 1933.—The inter-relationship of the semi-vectors introduced by Einstein and Mayer [see Abstract 2227 (1933)] and spin space [see Abstract 2813 (1933)] is discussed. J. S. G. T.

3947. Milne's Theory of World Structure. W. O. Kermack and W. H. McCrea. *Roy. Astron. Soc., M.N.* **93.** *pp.* **519–529,** *May,* **1933.**—It is shown that the "hydrodynamic" model proposed by E. A. Milne, for accounting for the recession of the spiral nebulæ as a purely kinematical phenomenon, is included as a limiting case, when the density tends to zero and the cosmical constant is zero, amongst the expanding universes of general relativity. The space of this universe is of negative curvature, and the matter in it possesses no equilibrium configuration. E. A. Milne's criticisms of general relativity are also met, and, in particular, it is shown that Milne's own theory implicitly assumes the existence of a "cosmic" time. [See Abstracts 1347 and 2820 (1933).] G. C. McV.

3948. Universe without Curvature. T. Takéuchi. *Phys. Math. Soc., Japan, Proc.* **15.** *pp.* **217–221,** *May,* **1933.** *In English.*—The author raises the question whether Einstein's cosmological term must be positive, zero or negative, in connection with the red-shift phenomena in the flat kinetic universe. Next the conservation of energy in the whole universe is analysed. [See also Abstract 3346 (1931).] AUTHOR.

3949. Spontaneous Absorption of Radiation and the Red-Shift of Lines in the Spectrum of the Nebulæ. E. Sevin. *Comptes Rendus,* **197.** *pp.* **26–28,** *July* **3, 1933.**—A contracting model of the universe is discussed, in which matter is annihilated and the quantity of available energy in the universe decreases. G. C. McV.

SOLUTION.

3950. Theory of the Rate of Solution of Solid into Liquid. S. Miyamoto. *Faraday Soc., Trans.* **29.** *pp.* **789–794,** *July,* **1933.**—A theory is proposed based on the assumptions that among the molecules which make up the solid surface, only those whose components of energy of vibration at right angles to the interface exceed a threshold value ϵ_0 can enter into the liquid phase, and that among the molecules in the liquid phase only those which collide with the interface with velocities whose components at right angles to the interface exceed a threshold value u_0 can deposit on the solid surface. The theory is shown to interpret numerous experimental facts, and the solubility of a solid is given by

$$c_{\alpha} = \frac{N_0}{N}\sqrt{\frac{2\pi M}{RT}}\, e^{-\frac{1}{RT}\left(N\epsilon_0 - \frac{Mu_0^2}{2}\right)},$$

where N_0 is the number of molecules per unit area of the solid surface, and M is the molecular weight of the solid. N. M. B.

3951. Theory of Water and Ionic Solution, with Particular Reference to Ḣ and OH′ Ions. J. D. Bernal and R. H. Fowler. *J. Chem. Phys.* **1.** *pp.* **515–548,** *Aug.,* **1933.**—On the basis of the model of the water molecule derived from spectral and X-ray data and a proposed internal structure for water, the following properties of water and ionic solutions have been deduced quantitatively in good agreement with experiment: (1) the crystal structure of ice; (2) the X-ray diffraction curve for water; (3) the total energy of water and ice; (4) the degree of hydration of positive and negative ions in water; (5) the heats of solutions of ions; and (6) the mobility of hydrogen and hydroxyl ions in water; and the following are inferred in a qualitative way: (7) the density and density changes of water; (8) the explanation of the unique position of water among molecular liquids; (9) the dielectric properties of water and ice; (10) the viscosities of dilute ionic solutions; and (11) the viscosities of concentrated acids. AUTHORS.

See also Abstracts 3875, 3954, 4249.

SURFACE TENSION AND COHESION.

3952. Capillary Ascent or Depression of Liquids in Cylindrical Tubes. A. W. Porter. *Faraday Soc., Trans.* 29. *pp.* 702–707, *June,* 1933.—The capillary correction in manometry depends on the shape of the meniscus and is complicated for mercury by the way it sticks to the glass and by doubt concerning the correct values for the surface tension. Corrected tables are given. A. S. C. L.

3953. Surface Tension of Mercury and of Water in Contact with Saturated Vapours of Organic Liquids. F. E. Bartell, L. O. Case and H. Brown. *Am. Chem. Soc., J.* 55. *pp.* 2769–2776, *July,* 1933.—The surface tension of Hg was determined in the presence of saturated vapours of organic substances by the drop-weight method. Measurements were also made by the capillary rise of water saturated by organic substances and in contact with their vapours. The results show that Antonoff's rule for interfacial tension applies. A. S. C. L.

3954. Attraction of Insoluble Substances by Liquid Interfaces. H. Devaux. *Comptes Rendus,* 197. *pp.* 105–108, *July* 10, 1933.—Since the majority of common elements and insoluble compounds when finely divided can easily be made to float at the liquid surface, they are only partially wetted. It is thence deduced that such powders will be more powerfully held at the surface of separation of two non-miscible liquids than at the surface of either liquid separately. In confirmation a remarkable accumulation at the interface is observed, even when the solid substance is obtained by precipitation. When the substance is in the colloidal state the accumulation is smaller or absent, but the destruction of the colloidal state results in accumulation. The interfacial attraction even extends to the molecules of certain dissolved bodies which are thus adsorbed or even drawn out of solution. P. H. B.

3955. Electrocapillary Maximum for a Mercury Electrode. S. R. Craxford. *Phil. Mag.* 16. *pp.* 66–79, *July,* 1933.—Electrocapillary curves are determined by the drop-weight method. The potential across the mercury/solution interface is fixed by the composition of the solution. The potential of the dropping mercury differs from that of a stationary mercury electrode in the same solution. The surface tension/drop potential curve has no peak value at $+0\cdot5$ volt such as has been observed in the curve surface tension/stationary mercury electrode. The theory of electrocapillarity is discussed, and the Lippmann treatment is preferred. A. S. C. L.

TIME (STANDARDS, MEASUREMENTS, APPARATUS).

3956. Clock Corrections from Photographic Zenith Tube Observations. F. B. Littell. *Astron. J. No.* 994. *pp.* 9–11, *June* 19, 1933.—The method employed is by star images, obtained by moving the plate-carriage (by clockwork) so as to follow the diurnal motion of the star, using 15-second exposures; after three 15-second exposures and about 5 seconds before the time of meridian passage of the star, the objective and plate-carriage are rotated through 180° and a second series of exposures registered on the plate as the plate-carrier moves back over the same course, and the time record registers the times when it is at the same points as were previously recorded on its forward movement. There are about 27 time records for each of the 6 star images, or about 81 pairs; thus any corresponding pair will give the time of meridian passage of the star, though in practice only 12 pairs are used. The stars (of about mag. 7·5) places have been determined with the 9-inch transit. Results are given for May 14–Oct. 30, 1932, in graphs with Shortt No. 41 as the standard clock and Shortt No. 38 as the comparison, one graph illustrating the effect of equinoctial notation corrections, and the other the observed clock corrections for Shortt No. 41 from observations with the zenith tube, and the Prin transits Nos. 1 and 2. Systematic differences are found in the second graph, but no definite explanation is forthcoming for them. A. S. D. M.

3957. Quartz Clocks as Timekeepers. A. Scheibe. *Naturwiss.* 21. *pp.* 506–512, *July* 7, 1933.—A discussion of the time-keeping qualities of clocks is given, and some of the advantages of quartz clocks over the pendulum clock are mentioned. The behaviour of Marrison's crystal clock [see Abstract 3908 (1930)] and of Scheibe and Adelberger's quartz clock [see Abstract 500 (1933)] is considered, and it is concluded that our present knowledge of the variations to which such clocks are liable is insufficient to justify the prediction of their behaviour as regards constancy of time-keeping for a period of more than a few weeks. Safe extrapolation over periods of months is, however, aimed at. G. G. S.

See also Abstract 3969.

VACUA, HIGH.

3958. Pirani Gauge. Y. Takamura. *Phys. Math. Soc., Japan, Proc.* 15. *pp.* 210–216, *May*, 1933. *In English.*—Campbell's formula is derived theoretically, and the constant k is given as a function of the temperature T of the filament and T_0 of the container. The variation of k with the resistance R of the filament and the temperature T_0 of the container are investigated by the use of a Pirani gauge modified by Hall. The k is approximately constant, but decreases slowly with the pressure, increasing under given conditions. T is calculated by a theoretical formula, and a considerable correction is needed in order that the experimental facts agree with the theory. AUTHOR.

VISCOSITY, FRICTION AND LUBRICATION.

3959. Ellipsoidal Viscosity Distribution. W. S. Kimball. *Phil. Mag.* 16. *pp.* 1–49, *July*, 1933.—Using Newtonian mechanics and elasticity theory, the author has derived a viscosity distribution function which is ellipsoidal in that the exponents, when set equal to a certain constant, are true strain ellipsoids as well as equal probability ellipsoids in velocity space. Boltzmann's continuity equation can be transformed to represent rate of change of range, strain or entropy, and the distribution found is an exact solution. G. E. A.

3960. Electromagnetic Measurement of Internal Friction. L. Polotowsky. *Phys. Zeits. d. Sowjetunion,* 3. 6. *pp.* 555–560, 1933. *In German.*—Torsional oscillations are set up in a bar of metal by means of a valve oscillator. The eddy currents generated in the bar by the field from a coil connected to the oscillator react with a static magnetic field to produce the necessary impulses. The motion of the other end of the bar is made to operate a similar electromagnetic device, which records the torsional oscillations; and from the logarithmic decrement of these oscillations the coefficient of internal friction η is calculated. For Al, Cu, and steel, η passes through a minimum value as the amplitude decreases. For amplitudes ϕ above this value η is a quadratic function of ϕ. By employing the third overtone of the bar evidence is obtained showing that the internal friction does not depend upon the frequency. J. P. A.

3961. Viscous Resistance in Capillaries of Non-Uniform Radius. D. A. McLean. *Physics,* 4. *pp.* 279–284, *Aug.,* 1933.—The viscous resistance offered by a tube of varying radius to the flow of a liquid is discussed. Three cases are taken up, for which solutions assume the forms: (1) capillary tube viscometer: $\eta = \pi P/8QA_L$. (2) Bingham and Murray plastometer: $\eta = P(t - t_1)/8[f_3(l) - f_3(l_1)]$. (3) apparatus for studies of wetting under dynamic conditions: $\gamma = 4\eta f_5(l)/t$. The functions A_L, $f_3(l)$, and $f_5(l)$, may be obtained from a calibration of the tube, use being made of graphical integration. AUTHOR.

3962. Determination of Absolute Viscosity. J. R. Coe, Jr. *Physics,* 4. *pp.* 274–278, *Aug.,* 1933.—An apparatus designed for the precise measurement of absolute viscosity is described. The liquid being studied is caused to flow from one reservoir through a capillary tube into a second reservoir, the pressure difference between the two being measured with a differential manometer. Various rates of flow are caused by injection of mercury into the upstream reservoir from a cylinder by means of a uniform piston driven at constant speed by a synchronous motor through a gear train. A number of interchangeable capillaries of different bore diameters and lengths can be employed. The displacement apparatus and the viscometer are thermostated in baths designed for precise temperature control. A machine designed and built to lap the bores of capillaries into right circular cylinders is described. AUTHOR.

See also Abstracts 3911, 3940, 3951.

ASTRONOMY AND ASTROPHYSICS.

ASTRONOMICAL APPARATUS AND OBSERVATORY EQUIPMENT

3963. Investigation of Measuring Machine and Methods for Measuring Differential Proper Motions. P. J. van Rhijn and J. J. Raimond, Jr. *Roy. Astron. Soc., M.N.* 93. *pp.* 635–647, *June*, 1933.—The measuring machine at the Kapteyn Laboratory is of the Repsold type; its scales can be adjusted to the zero point adopted in the computation of the plate co-ordinates, and the microscope to two different focal settings. In deriving relative proper motions the distances between the images of the two epochs can be compared (1) by film to film in the measuring engine, or (2) by direct measurement of the two separate plates with respect to the same division lines of the scales, or (3) by the plates clamped glass to film, both films being thus turned towards the objective of the microscope, the focussing on the two films being at different settings. The second method gives much larger probable errors than the first or third, and certainly contains error depending on the temperature of the room. The alternating focus of the third method does not introduce any appreciable error, even when the glass is not plate, and the variation in its thickness may amount to 0·3 mm. The probable errors in measurement of a *Carte du Ciel* plate are discussed. A. S. D. M.

3964. Optical Tests of the 69-Inch Perkins Observatory Reflector. H. T. Stetson. *J.O.S.A.* 23. *pp.* 293–297, *Aug.*, 1933.—The large disc of glass cast by the Bureau of Standards in May, 1927, has emerged into the completed paraboloidal reflector which has been placed in the Perkins Observatory telescope at Delaware, Ohio. Before removal of the glass to Delaware, an extensive series of optical tests were made in the testing laboratory of the J. W. Fecker Company, in Pittsburgh, where the optical surface of the mirror was ground and figured. Some 3000 settings were made by the knife-edge test at the centre of curvature. Excellent agreement was found among different observers. Computed results show the mean focal length of the mirror to be 24 ft. 11¾ in. and the departures from this value for different zones of varying radii to be not over 0·1 mm. as would be tested in parallel light reflected to a focus. Tests were also made by the Hartmann method and a comparison made between the results of the two methods. The value of the Hartmann criterion for the mirror from laboratory tests is placed at 0·14. AUTHOR.

See also Abstracts 3943, 3956, 3993, 4064, 4079.

COMETS AND METEORS.

3965. Observation of Bolide of 15th May, 1933. J. C. Sola. *Comptes Rendus*, 197. *pp.* 128–130, *July* 10, 1933.—The author did not himself actually observe this meteor, being engaged at the time in photographing minor planets in another region of the sky, but its light fogged the plate in spite of its short duration (5 to 6 sec.). Other observations gave it first as white, then green, then red, and when distant 170 km. it was brilliant enough for reading. It had a series of bright filaments with jets coming back from its head; towards the end drops of fire fell from the head. Noise lasting for 15 sec. was heard about 2 min. after the apparition. At first appearance it was 176 km. high, between Toulouse and Castres and at disappearance 44 km. over the sea about 100 km. from Barcelona ; its relative speed was 50 km./sec. ; its heliocentric velocity of the order of 60 km./sec. ; its radiant, $\alpha = 5^h 41^m$, $\delta = + 74° 13'$. Using the fog on the plate in comparison with that made by the full moon, its light intensity would imply that the diameter of the nucleus (supposed spherical) was 94 m. and its mass (if of iron) more than 3 million tons ; the author suggests in view of this impossible mass that it consisted of a cluster of stones in contact, kept so by gravity, and that these vaporised for the most part and lost the whole of their relative motion. He suggests that it was a small comet. A. S. D. M.

COSMOGONY.

3966. Age of the Universe and of the Earth. E. Belot. *Comptes Rendus*, 197. *pp.* 126–128, *July* 10, 1933.—The density of Antares is about 10^{-8}, a large fraction of that of the dark nebula (10^{-10} about), which by encounter with stars has been deprived of its denser elements leaving a less dense residue (10^{-15} about) for luminous nebulæ. The author dates the nebular era as the origin of the universe, and this is successively followed by the stellar and planetary eras. The date of the earth from radioactive research is given as between 500 and 3000 million years, this being really the age of the protosol. He discusses Öpik's work on meteorites and the age of the universe [see Abstract 3204 (1932)] which gives the ages of like order as the above. A. S. D. M.

3967. Origin of the Solar System. W. J. Luyten. *Zeits. f. Astrophysik*, 7. *pp.* 46–57, *July* 24, 1933.—The collision theory for the origin of the solar system in the form proposed by Jeffreys [see Abstracts 3293 (1929), 958 (1930) and 128 (1933)] is discussed following the criticisms first made by van Anda, and it is shown that several errors have been made in the calculations. Furthermore it is shown that the underlying assumptions are entirely too vague to permit the making of any quantitative estimates, as its author claims. Some qualitative objections are advanced against the theory, and the more recent proposal of Gunn [see Abstract 1902 (1932)] is briefly discussed. AUTHOR.

DYNAMICAL PROBLEMS (ASTRONOMICAL).

See Abstract 3972.

NEBULÆ.

3968. Intensity Distribution in Spectrum Lines of Orion Nebula. W. Baade, F. Goos, P. P. Koch and R. Minkowski. *Zeits. f. Astrophysik*, 6. *pp.* 355–384, *June* 21, 1933.—The distribution of intensity in the nebular lines N_1, N_2 and $H\beta$ is discussed in relation to different parts of the nebula on the basis of a photographic photometry of plates made with an interference spectrograph attached to the Bergedorf 1-metre reflector. Full details of apparatus and reductions are given. The distribution of intensity was found irregular but dependent on the region ; but integrated over all regions gave a Doppler distribution. The earlier observations of Fabry and Buisson are thus verified ; and if the effect were assigned to a purely thermodynamic origin, their conclusion that the molecular weight of the gas was about 3 ("Nebulium") would be fully confirmed. The departure from the actual atomic weight of N is now explained by the presence of turbulent motions in the gaseous masses, and an attempt is made to separate this mechanical Doppler effect from the thermal one. The mean value of the ratio of the intensities $N_1/N_2 = 3 \cdot 7$ (theoretically about 3). T. L. M.

See also Abstracts 3947, 3949, 3970.

PLANETS.

3969. Motion of the Moon, 1923–1931. E. W. Brown. *Roy. Astron. Soc., M.N.* 93. *pp.* 603–619, *June*, 1933.—The author summarises the results of a discussion of 3673 occultations by the Moon; tables give normal solutions for each lunation, overlapping quarterly means, annual means, also annual normal solutions treating each occultation as of unit weight. A comparison is made with Greenwich and Washington meridian observations; annual mean values are deduced from a combination of all material. Assuming that the annual differences are ascribable to changes in our measure of time (the Earth's rate of rotation), the latter appears to have been nearly constant over the period; a small change appears to have occurred in 1927, possibly also in 1923–4; the probable error of the annual rate as found from all observations does not appear greater than 0·2 second. An annual oscillation in the longitude with coefficient averaging 0″·3 and increasing in the later years is shown by occultation observations; considerable discrepancy with meridian observations is discussed. A new 14-month oscillation in the latitude is shown by both types of observation, but with opposite phase; in order to trace the origin, the systematic errors of the limb and libration require investigation; systematic errors in the star positions used also call for research. T. L. M.

STARS.

3970. Magnitude Frequency Distribution of Wolf-Rayet Stars. D. Hoffleit. *Harvard College Obs., Bull.* 892. *pp.* 15–19, *July* 1, 1933. —The author examines the magnitude frequency of Wolf-Rayet stars, for 50 in the Large Magellanic Cloud, for 68 in the Galaxy, for 13 near η Carinae, and for 14 in the Cygnus Cloud, according as they are involved, or are not involved in nebulosity. The Magellanic Cloud nebulosity is usually bright, in the other cases usually dark, yet in both cases the mean frequency magnitude of the stars involved in nebulosity is about two magnitudes brighter than those not so involved, which is contrary to expectation. This may therefore be due to difference of the content of the stars, and Miss Payne and Beals have divided the Wolf-Rayet stars into a carbon group and a non-carbon or nitrogen group, the mean difference in magnitude frequency being here about 2 magnitudes also, and there is no correlation with nebulosity. Struve has found that the brighter nitrogen stars are more distant than the carbon; Wilson, that the mean distances of carbon and of nitrogen stars do not differ greatly, but that the brighter Wolf-Rayet stars tend to be of the nitrogen group. A. S. D. M.

3971. Photovisual Magnitude of the Companion of Sirius. A. N. Vyssotsky. *Astrophys. J.* 78. *pp.* 1–8, *July*, 1933.—The photovisual magnitude of Sirius B has been determined anew by two different methods designed to eliminate systematic errors: (1) by using a coarse grating and (2) by forming artificial double stars comparable to Sirius A and

B on the photographic plate. The first method gives the magnitude 7·25 and the second gives 6·91, the mean being 7·1 as compared with Wendell's value of 8·44. AUTHOR.

3972. Orbit of a Double Star. L. Gialanella. *Accad. Lincei, Atti,* 17. *pp.* 820–824, *May* 21, 1933.—A mixed observational, mathematical, and graphic method of determining the elliptical elements of the Keplerian orbit of a double star, spectroscopically, with two spectrograms. The components of the speed of the barocentric of the binary stellar system with reference to the earth are also determined. A. D.

3973. Variable Spectrum of γ Cassiopeiæ. W. J. S. Lockyer. *Roy. Astron. Soc., M.N.* 93. *pp.* 619–623, *June,* 1933.—The author has examined a series of plates made 1892–96 and 1900–04 at Solar Physics Observatory (S. Kensington); the former range corroborates his conclusions as to lack of constancy in the H lines in a 4-year period [see Abstract 2853 (1933)]; the latter range though very incomplete is not inconsistent; observations in 1933 also confirm the author's prediction of minimum.
T. L. M.

3974. Spectroscopic Determination of Stellar Rotation and its Effects on Line Profiles. J. A. Carroll. *Roy. Astron. Soc., M.N.* 93. *pp.* 478–507, *May,* 1933.—A new method is developed for testing whether or not the observed shape of a line in a stellar spectrum can be due to rotation of the star. The observed line profile depends on the true form of the line, on the law of darkening and on the star's rotational speed. In the equation giving the observed form of the line in terms of the true form, it is demonstrated that certain zeros of the observed form depend only on the law of darkening and the rotational speed and can be calculated without a knowledge of the true form of the line. Comparison of the zeros thus found with those observed then yields the rotational velocity, and hence the true form of the line can be calculated. Special cases of the theory are dealt with in some detail, and the possibility of testing for the law of darkening towards the limb in a rotating star by the method is pointed out. [See following Abstract.] G. C. McV.

3975. Rotational Speeds of the Stars. J. A. Carroll and L. J. Ingram. *Roy. Astron. Soc., M.N.* 93. *pp.* 508–519, *May,* 1933.—The new method [see preceding Abstract] for finding the rotational speed of a star from the shape of the line profiles in its spectrum is applied to the lines He 4387 and 4471, and Mg 4481 in the stars 44 Ori, 44 Per and 39 Ori. The distortions of the lines are shown to be due to rotation, and the equatorial line of sight velocities are 110 km./sec., 39 km./sec. and 180 km./sec. for the three stars respectively. The method is also applied to the star Algol, whose rotational speed is known from other sources, and yields a result in very close agreement with that otherwise determined. G. C. McV.

3976. Forbidden Lines in Astrophysical Sources. J. C. Boyce, D. H. Menzel and Cecilia H. Payne. *Nat. Acad. Sci., Proc.* 19. *pp.* 581–591, *June,* 1933.—A survey is made of the metastable states of the atoms from hydrogen to argon, and a list is compiled of the forbidden lines arising from transitions between these states which have been identified in astrophysical sources. The two strongest lines hitherto unidentified in the nebular spectrum, λλ3869 and 3968 Å, are recognised as due to neon (Ne III), an element which has not been previously recognised in astrophysical sources. J. E. K.

3977. Statistical Study of the Rotational Broadening of the Absorption Line Mg II λ 4481 in 413 Stars of Class A. Christine Westgate. *Astrophys. J.* 78. *pp.* 46–53, *July*, 1933.—The axial rotations of stars, as estimated from the broadening of the Mg II line λ 4481, is studied statistically for 413 stars of class A. The measurements of line width were converted into their corresponding equatorial velocities in km./sec. The graph of observed frequencies of rotational velocities is compared with a theoretical curve which was constructed with regard to the probability of different inclinations of axes and with the assumption of an arbitrary distribution of real equatorial velocities among stars. The best approximation to the observed curve is obtained by assuming a distribution as given in an accompanying table. AUTHOR.

3978. Spectra of 17 Leporis and 7 ε Aurigae. J. A. Hynek. *Astrophys. J.* 78. *pp.* 54–63, *July*, 1933.—The intensity gradients of absorption lines in the spectra of 17 Leporis (A0) and 7 ε Aurigae (F5) have been examined. 17 Leporis shows a steeper gradient than ε Aurigae does; faint lines become unmeasurable in 17 Leporis, while the corresponding lines in ε Aurigae are still well defined, but strong lines are as strong as, or stronger than, those in ε Aurigae. The hydrogen lines are not comparable, being much stronger and broader in 17 Leporis. Six Ti II multiplets were examined in the two stars. The gradients within each multiplet indicate the same effect that is shown by the entire element in the two stars. Further confirmation is given of the square-root law of absorption intensities. AUTHOR.

3979. Interpretation of Nova Spectra. D. H. Menzel and Cecilia H. Payne. *Nat. Acad. Sci., Proc.* 19. *pp.* 641–648, *July* 15, 1933.—After a Nova maximum, bright lines keep their position, absorption lines shift at different rates, becoming fainter as the bright-line spectrum increases in intensity. Instead of the ejection of a shell at maximum, the authors suggest that it is only the photosphere that is blown away at the first outburst, the star becoming in structure (though perhaps not physically) a planetary nebula. The series from absorption to bright-line, then to nebular and to a Wolf-Rayet (W) spectrum agrees with this. Four schematic profiles are given for a Nova expanding at high constant velocity for (*a*) uniform disc, (*b*) limb darkened, (*c*) centre dark, limb bright, (*d*) emission from transparent expanding shell. The last should be rectangular [see Abstract 1151 (1932)], but is not so seen in nature since the material is ejected unsymmetrically; cases of (*c*) are shown in actual Novæ. Absorption is at the star's low level, emission at high. W stars seem to lose atmospheres slowly but steadily [see Abstract 1795 (1930)] and the dense nebulous envelope screens the "forbidden" nebular lines; so too with Novæ, and their spectral changes follow a logical sequence. For any one atom, the auroral lines appear first, in a few days or weeks the nebular lines (increasing in strength and perhaps surpassing the auroral), furnishing a means of line identification in the Nova spectrum. Tables are given of the prominent lines in three typical Novæ, showing, especially, differences in the behaviour of ionised iron lines; in only two Novæ have forbidden Fe II lines appeared [but for ex-Nova η Carinae, see Abstract 2649 (1928)]. In the final Nova stages, forbidden lines usually disappear [see Abstract 2317 (1928)]. The bright-line spectra can generally be interpreted, as by rapidly rising temperature, rapidly falling pressure, and rapidly increasing dilution of radiation. A. S. D. M.

3980. Condensation in Stellar Atmospheres. R. Wildt. *Zeits. f. Astrophysik,* 6. *pp.* 345–354, *June* 21, 1933.—The author examines the physical conditions for the appearance of condensation of materials of high melting point in the atmospheres of late-type stars ; the limiting velocity of fall of drops, and hence the stability of such clouds ; and the substances for which such condensation is possible. He concludes that such a phenomenon is not improbable in long-period variable stars and that the life of such clouds might be considerable. The onset of condensation may also explain the absence of giant stars after type M8 on the Russell diagram. **Erratum,** *ibid.* 7. *p.* 152, *July* 24, 1933. T. L. M.

3981. Luminosity Distribution and Average Density of Matter in Twenty-Five Groups of Galaxies. H. Shapley. *Nat. Acad. Sci., Proc.* 19. *pp.* 591–596, *June,* 1933.—An important feature in the non-uniform distribution of galaxies is the occurrence of many physical groups. Within these groups the average density of matter is greater than the average for all space. The mean density of matter in twenty-five groups of galaxies is computed, and an approximate value of 5×10^{-70} galaxies per cc. is obtained. In a few relatively small groups, where the individual galaxies are nearly in contact, the mean density may be ten times as great. The luminosity distribution of the twenty-five groups is also investigated, and there is found to be great diversity in the type of distribution. From a revised value of $-14{\cdot}5$ for the mean absolute photographic magnitude of a galaxy, the rate of recession of the galaxies is computed to be 405 km./sec. per megaparsec. J. E. K.

3982. Absorption and Space Reddening in the Galaxy from the Colours of B-Stars. J. Stebbins and C. M. Huffer. *Nat. Acad. Sci., Proc.* 19. *pp.* 597–604, *June,* 1933.—From a study of the reddening of the B-stars it is concluded that the galactic system is filled near the median plane with a dark absorbing layer which reddens all stars at a sufficient distance and blots out everything behind it. Calculated distances of objects in low galactic latitudes must be revised with allowance for absorption. The globular clusters in the direction of the nucleus are probably all on the same side of the galactic centre as the earth. The total mass of the dark absorbing matter in the galaxy may well be greater than the total mass of the material in the form of luminous stars. J. E. K.

3983. Selective Absorption of Light in Pleiades. D. Barbier. *Comptes Rendus,* 196. *pp.* 1868–1871, *June* 19, 1933.—The author justifies by Miss Payne's Memoir [see Abstract 4879 (1932)] the suggestion of ten Bruggencate that the Pleiades are yellower than is warranted by their spectral types. The magnitudes are found, by filters, for four wavelengths (λ_1, etc.), and the group is divided into two parts—the physical members and the field members, which may only in part be physically related. The stars do not obey Planck's Law, and the residuals (R) are attributed to the effect of selective absorption following Rayleigh's Law, the coefficient β depending on the thickness of nebular material and varying from one star to another ; these values of β are positive, that is for red magnitudes the stars appear redder than if there was no diffusion, and for ultra-violet magnitudes the stars appear bluer. The repartition curves of R_1 and R_4 are not normal Gauss curves but dissymetrical, having an excess of large magnitudes ; there is a correlation between R_1 and R_4, but not between them and spectral type. The R_4 (red residuals) for true Pleiades members appear to depend on the stars R.A, suggesting a form

V. 19

for the nebula. The R_1 (violet) do not give certain results. The residuals for four stars which are certainly behind the Pleiades and for two stars in front are computed, giving a mean for R_1 of $-0\cdot60$ and $-0\cdot23$, for R_4 of $-0\cdot60$ and $-0\cdot08$ respectively, thus indicating an absorption corresponding to Rayleigh's Law A. S. D. M.

3984. Proper Motions of Stars in Region of Cluster M37 (N.G.C. 2099). Violet F. White. *Roy. Astron. Soc., M.N.* 93. *pp.* 647–652, *June*, 1933—The plates of the galactic cluster M37 (classed by Melotte, as " a fine example of Class II ") were taken in 1895 by W. E. Wilson and 1930 by C. C. L. Gregory. The region includes without the cluster 97 stars of magnitude range 9–13, and within it 126 stars of which 8 stars, brighter than mag. 10, though *in* the cluster are not considered as belonging *to* it. Both plates were photographed directly. Proper motions (μ_x μ_y) are obtained relative to 32 of the faintest stars (about 12·5 mag.) by the equations: $\mu_x=M_x+a+bx+cy$; $\mu_y=M_y+d+ex+fy$, and as multiples of the scale unit, 0·00005 cm. Two figures are given of the centennial proper motions of 96 stars (mean magnitudes 12 and 10) without the cluster, and of 126 stars (mean magnitude 12·2) within it. The absolute centennial proper motion of the cluster is: $\mu_\alpha=-0''\cdot1$, $\mu_\delta=-0''\cdot1$. A third figure is of the drift curve shown by the 97 stars (mean magnitude 11·2). The distribution of proper motions in the cluster is almost circular. A. S. D. M.

3985. Eclipsing Binary Star RZ Cassiopeiæ. J. Ellsworth. *Comptes Rendus*, 196. *pp.* 1212–1214, *April* 24, 1933.—Orbital data derived from photometric and spectroscopic observations have shown great disagreement. The author shows that alternative solutions give fair agreement: $e=0\cdot013$, $\omega=132°$ (photometric); $e=0\cdot018$, $\omega=125°$ (spectroscopic). These, however, involve a retrograde motion of the apsides; the author therefore proposes a return to the view of Chandler that a third body is involved. T. L. M.

See also Abstracts 3966, 3994, 4079, 4112.

SUN.

3986. Solar Granulation. H. Strebel. *Zeits. f. Astrophysik*, 6. *pp.* 313–329, *May* 11, 1933.—An attempt is made to show that the true form of the granulation of the sun is markedly polygonal as opposed to the results of photographical investigations which, on account of a series of optical-technical defects, only permit the recognition of rounded forms. The diameter of the individual granulations depends considerably on the wavelength of the light with which the photograph is taken. The diameters are greatest in photographs taken with ultra-violet light, and in these photographs account must be taken of large differences of optical brightness between granulations and background and also of the spectroscopically effective differences between the intensity and the quality of the radiation. J. E. K.

3987. Variation of Intensity and Relative Intensity of Coronal Lines. W. Grotrian. *Zeits. f. Astrophysik*, 7. *pp.* 26–45, *July* 24, 1933.—Continuation of Potsdam eclipse results (1929, Takengon). The variation of intensity of 11 lines of the coronal spectrum is discussed as a function of distance from the sun's limb. The results are compared with the variation of the continuous spectrum [see Abstract 361 (1932)]. Apart from localised increases of the intensity of individual lines, the intensity of the lines is proportional to that of the continuous spectrum; the possible physical significance of this relation is discussed. An attempt to link pairs of lines on the basis of similar behaviour leads to no definite conclusions even for Mitchell's pairs. The relative intensity of 12 lines is measured; order: 5303 (122), 3388 (20), 6374 (10), others from 6 down to 0·8 on same scale; 5303 is stronger than all the others combined. All lines contain only 1/160 of the total coronal energy; hence the green line does not sensibly affect the colour of the corona. T. L. M.

3988. Form of a Sunspot. (Miss) P. Parchomenko. *Zeits. f. Astrophysik,* 7. *pp.* 22–25, *July* 24, 1933.—On the basis of the radiative equilibrium theory, an expression for the approximate form of the section of a sunspot is derived, and shown to agree in general with the observational curve of Barabascheff and Semejkin [see Abstract 4862 (1932)]. T. L. M.

3989. Solar Radiation in 1931 and 1932. G. Armellini and G. Andrissi. *Accad. Lincei, Atti,* 17. *pp.* 605–610, *April* 23, 1933.—In continuation of the results given [see Abstract 2875 (1933)] of the solar radiation in 1929 and 1930, as deduced from observations at Campidoglio with the pyrheliometer, results are here tabulated for 1931 and 1932, and are combined with those of the two previous years. As far as the observations go, during this short period, they show that the coefficient of atmospheric absorption found at Rome has an annual average of 0·393, which is nearly double that given in Müller's Potsdam tables, but agrees well with that found at Washington, U.S.A. M. A. E.

3990. Solar Radiation Measurements at Poona in 1931. S. S. Kohli. *Indian Meteorolog. Dept., Mem.* 25. 10. *pp.* 327–342, 1932.—In the first part of this paper are analysed values of solar radiation at normal incidence made at Poona during the year 1931 with an Angström pyrheliometer with and without red filter Schott F 4512. Monthly mean values are tabulated, showing the influence of time of the year and air mass. Angström and Gorczynski's turbidity coefficients and curves published by Kimball have been used for studying atmospheric depletions. A comparison is made of similar measurements at other places. In the second part, measurements with a Callendar pyranometer of the total energy received from the sun and sky on a horizontal surface are similarly analysed and discussed. AUTHOR.

3991. Use of Glass Colour Screens in the Study of Atmospheric Depletion of Solar Radiation. H. H. Kimball and I. F. Hand. *Monthly Weather Rev.* 61. *pp.* 80–83, *March,* 1933.—Atmospheric depletion of solar radiation is due to (1) scattering by gas molecules and dust, and (2) selective absorption by atmospheric gases, mainly water vapour. The scattering by pure dry air is obtained from King's modification of Rayleigh's equations. If the total loss by scattering and by pure dry air is found from pyrheliometer measurements the absorption by water vapour can be calculated. Using Fowle's relation between the amount of water vapour in the atmosphere and its absorption in the infra-red bands, the amount of water vapour can be calculated. The results obtained from a spectrobologram of solar radiation at the Smithsonian Institution are used in this way and the turbidity factor (β) found by the use of special yellow and red screens. The magnitude of β and the amount of water vapour so found are smaller than expected from the surface observations. Possible causes are discussed. R. S. R.

3992. Estimation of Solar Radiation in Relation to Warming Effects on the Human Body. H. M. Vernon. *Roy. Meteorolog. Soc., J.* 59. *pp.* 239–249; *Disc.,* 250–252, *July,* 1933.—Following a suggestion first given by Aiken in 1887, that solar radiation should be measured by means of a black-painted metal globe, the author constructed and used such globes. These he terms globe thermometers. They are described and also the conditions under which they are used. The temperatures indicated by these instruments the author regards as an index of the warming effect of solar radiation on the human body. Temperatures are read when a sensation of comfortable warmth is experienced. The effect of wind velocity on these thermometers is investigated, and the results are given in tabular form. Suitable solar tests are difficult to obtain and the data are got largely from artificial radiant heat. The author and another were the subjects of experiment. In the *Discussion* it is pointed out that in addition to the work discussed in the paper, the influence of infra-red rays should be considered; also that there is need for simultaneous observations of humidity, of intensity of solar radiation, and of wind velocity as recorded by an anemometer. The author agrees that his data are incomplete, but contends that the measurement of wind by the method used by him is justifiable under the conditions of the experiment.

A. E. M. G.

3993. Greenwich Personality and the Equinox Correction. J. K. Fotheringham. *Roy. Astron. Soc., M.N.* 93. *pp.* 530–535, *May,* 1933.—It is shown that a discontinuity for the year 1915 in the measurements of the sun's right ascension made at Greenwich was due to a change of personnel rather than to the introduction of the moving-wire micrometer. The study of the observations leads to the conclusion that the fluctuation in the earth's rotation is accompanied by a fluctuation in the motion of the equinox. The resulting equinox correction fluctuates in the opposite direction to the right ascension as measured by Newcomb's equation.

G. C. McV.

3994. Central Intensities of Fraunhofer Lines. A. D. Thackeray. *Observatory,* 56. *pp.* 228–232, *July,* 1933.—It is difficult to explain theoretically the high observed central intensities of Fraunhofer lines. Eddington has shown that superelastic collisions would account for a certain "residual intensity"; he assumed a collision factor ϵ constant throughout the solar atmosphere, whilst Woolley considered the case in which ϵ is proportional to the pressure. Russell has shown that the solar atmosphere contains a very high proportion of hydrogen, this should increase the effect of collisions; the value of ϵ is accordingly estimated from Russell's data. This estimate shows, however, that it is unlikely that collisions can account for more than 10 % in the central intensities of the Fraunhofer lines. The best observations range between 3 and 30 %. Theory predicts higher central intensities in the spectra of dwarf stars than for giants, this is confirmed by observations of C. H. Payne.

J. E. K.

See also Abstract 4003.

GEOPHYSICS.

GEODESY.

3995. Crustal Warpings. E. A. Glennie. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 3. *pp.* 170–176, *May,* 1933.—The compensated geoid in India is found to be traversed by a great undulation. The positive area is about 500 miles long and 1500 miles in length. It cuts across rocks of all geological types, and of very different densities. This is a direct negation of the theory of isostasy. In India gravity anomalies seem to have no apparent relation to local conditions, as they should do on the Hayford hypothesis of local compensation. There seems to be only one possible explanation—namely, that they are due to a deep-seated, gentle undulation of the lower crustal layers underlying all the superficial rocks. Evidently there is a broad sweeping feature at great depth, uncompensated, since if it were compensated it would cause no surface anomaly of gravity. In consequence of this and other evidence, the author rejects entirely the hypothesis of isostatic compensation of topographical features, and erects in its place the new hypothesis of crustal warping, introducing a new gravity ϕ anomaly, called the crust anomaly, to take the place of the Hayford gravity anomaly. W. A. R.

3996. Crustal Warpings. R. Stoneley. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 3. *pp.* 176–181, *May,* 1933.—The author criticises the new hypothesis of crustal warping (see preceding Abstract) by treating the problem as one in spherical harmonics. He shows that the mathematical implications do not justify Glennie's inference. He points out that it is not necessary to suppose that the extreme hypotheses of complete compensation and of crustal warping without compensation are the only alternatives. **E. A. Glennie** (*ibid. p.* 181, *May,* 1933) in a short reply recognises the justice of the criticism, but points out that other considerations must be taken into account, and the final test must be correlation with the geological facts. W. A. R.

HYDROSPHERE, PHYSICS OF THE.

3997. Tides in a Hemispherical Ocean Bounded by a Continental Shelf along a Meridian. R. O. Street. *Roy. Astron. Soc., M.N. Geophys. Supplement,* 3. *pp.* 163–167, *May,* 1933.—In the present paper the theory of the semidiurnal tides of a hemispherical ocean bounded by a narrow belt of shallow water along a meridian is considered, and the results are similar to those obtained in an earlier paper [see Abstract 3614 (1932)]. The rotation of the earth had to be neglected. The effect of friction in the deep water has been ignored completely and in the belt of shallow water it has been included only when otherwise the oscillations would become indefinitely large. In general, the effect of a frictional force proportional to the speed of the current is to introduce a second order correction to the tidal heights, although its effect on the phase is more important. A special case is worked out and the results are compared with those of Proudman and Doodson. R. S. R.

3998. Wind Currents in Heterogeneous Waters. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 105–139, *May,* 1933. *In English.*—The author deals with the case of currents generated in water by the tangential stress of winds and a solution to the problem is obtained when the kinematic coefficient of eddy viscosity (K) varies with the depth in a specified way which can occur when the stratification of the water is heterogeneous and the vertical stability has gradient. The effect of the earth's rotation has been neglected, the tangential stress of the winds on the surface of the water is taken as any function of time, and the current first generated on the surface is propagated to deeper layers by the effect of eddy viscosity. Two numerical cases are treated in which K decreases or increases downwards, the surface value being in one case twice and in the other half that at the bottom. The problem may be applied also to (1) the linear conduction of heat when the thermal conductivity of the medium varies from point to point, and (2) the eddy conduction of momentum and scalar quantities in a fluid when the eddy viscosity is a function of space. R. S. R.

3999. Non-Steady Ocean Currents. Part I. K. Hidaka. *Imp. Marine Obs., Kobe, Japan, Mem.* 5. *pp.* 141–265, *May,* 1933. *In English.*—Reference is made to the theory of ocean currents in a steady state given by Ekman and others. The theory of ocean currents in the course of development by wind, slope of sea level, etc., has been investigated only with regard to the wind currents. In the present paper the properties of non-steady ocean currents, the gradual development of drift, slope and convection currents in an ocean initially at rest, and how they acquire a stationary state are investigated. In successive chapters are treated, (1) the synopsis of earlier investigations and the formation of the dynamical equations and orthogonal functions used; (2) the theory of non-steady drift currents for finite and infinite depth; solutions were computed numerically for the cases of constant and variable wind; a numerical solution was also obtained when the coefficient of virtual friction is a function of depth and it was applied to the current observed by Sverdrup on the N. Siberian shelf; the subsidence of drift currents was also studied; (3) an exactly similar method was applied to the non-steady slope currents, and numerical solutions are given for constant and variable slope and for constant and variable coefficient of virtual friction; (4) solutions for non-steady convection currents based on the principle that the horizontal pressure gradients are functions of depth and time; (5) theory of steady convection currents; a method is given to determine the convection current of Ekman's type from hydrographical data; (6) development of sea level near a coast when the direction and force of the wind vary with time, the slope of sea level also then varying with time; the inclination of the sea level near a coast is given as the solution of a Volterra's integral equation of the first kind. This equation can be solved numerically and an example is given when the wind blows perpendicular to the coast. The result can be applied when the north-westerly monsoon wind prevails over the Far East. R. S. R.

4000. Simplified Procedure for the Calculation of Pressure and Mass Distribution in the Sea. H. U. Sverdrup. *Geofysiske Publ.* 10. 1. [9 *pp.*], 1933.—Reference is made to tables prepared earlier by Hesselberg and the author for the calculation of the pressure and mass distribution in the sea, in a simplified way, by obtaining absolute values of

σ_t. In practice it is sufficient to calculate the anomalies as was done by Bjerknes and Sandström with the help of tables. The author shows in the present paper how the anomalies of specific volume and dynamic depth can be obtained easily if σ_t is known, and tables are provided in order to obtain a greater degree of accuracy. Much more rapid calculation is possible, but the same accuracy is obtainable as with both the earlier sets of tables.
R. S. R.

See also Abstract 4015.

LAND, PHYSICS OF THE.

4001. Magnetic Properties of Igneous Rocks. A. F. Hallimond and E. F. Herroun. *Roy. Soc., Proc.* 141. *pp.* 302–314, *Aug.* 1, 1933.—An account is given of the magnetic properties of igneous rocks taken from localities at which field surveys have been made with the magnetic vertical force variometer during the past few years. A group of several specimens was taken at each place in order to ensure uniformity, and from one of these a 3·3 cm. cube was cut for magnetic determination in the laboratory. The measurements were obtained by placing the cube near a freely suspended magnetised needle, in a partially neutralised field. The instrument was standardised by means of bars of known moment and by the time of swing. Susceptibility was measured by surrounding the cube with a coil. Specimens from Leicestershire (Charnwood Rocks) gave low values, but a measurable degree of permanent magnetisation and susceptibility was found for the Cleveland Dyke and for the dyke at Lornty in Perthshire. A method is developed for calculating the magnetic profile from the geological model assuming uniformity of magnetisation. Calculated and observed curves for the Lornty profiles show a fairly good agreement; they indicate that the north side of the dyke is south-polar, so that the magnetisation appears to be in the opposite sense to that recorded for certain dykes in Germany, and does not coincide with that which would be produced by cooling in the earth's present field. AUTHORS.

See also Abstracts 3995, 3996.

METEOROLOGY.

4002. Rapid Visual Photometric Method for Studying Atmospheric Ozone. J. Gauzit. *Comptes Rendus,* 197. *pp.* 178–180, *July* 10, 1933.—A comparison is made photometrically of the brightness of the sky, when cloudless or uniformly clouded, and of a standard lamp for various spectral regions near to the ozone absorption bands. A curve is obtained connecting the ratio of the logarithms of the luminous fluxes of sky and lamp with the wave-length, and from it the coefficient of absorption of the ozone layer is found. By working at different zenithal distances the thickness of the layer is determined, and from observations near the horizon the height of the layer is found. The results obtained at Montpellier in 1933 are tabulated. These show a greater thickness of the ozone layer than in 1931, and this variation is similar to that in 1912–14. [See also Abstract 530 (1933).] R. S. R.

4003. Radiothermic Economy of Fields of Snow and Glaciers. J. Devaux. *Ann. de Physique,* 20. *pp.* 5–67, *July–Aug.,* 1933.—Studies have been made in winter of the snow on the Pic du Midi and in summer of the glaciers in the Pyrenees, Alps and Greenland. The temperature of the

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snow was obtained by thermometers and Cu-constantan thermocouples and the main characteristics of the diurnal variation at different depths, the influence of the season, of relief, and of the type and amount of clouds are discussed. Under a clear sky the diurnal variation at the surface is large even with small variations of air temperature. The thermal conductivity (k) of snow was obtained for isothermal planes, cylinders and spheres. To a first approximation k depends only on density (ρ) and $k = 7\,(1 + 100\rho^2)10^{-5}$ cal./cm. sec. when $0{\cdot}1 < \rho < 0{\cdot}6$. Photometric and actinometric measurements of the albedo and consequent absorption factor of snow and glaciers for solar radiation were made. The albedo for snow is 0·8 to 0·9 and for fresh snow even 0·95. For glaciers the absorption is greater in the red than in the green. The dependence of absorption on density, depth, inclination and age of the glacier ice is discussed. An actinometer sounding provides information regarding the penetration of solar radiation into glaciers. The diffusive flow increases exponentially with depth. The influences of wave-length and glacier structure are discussed. Further, the radio-thermic resistance of glaciers is shown. Finally, theoretical considerations provide a means of calculating the albedo of the interior of snow and the coefficient of absorption of ice and also show that the diffused flow ought to decrease exponentially in certain different regions.
R. S. R.

4004. Kinematics and Dynamics of Stable Atmospheric Vortices. J. Letzmann. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 167–205, 1933.—The object of the paper was to investigate experimentally problems associated with the origin and method of action of vortices in a frictional fluid and thus to fill gaps which are evident in the theoretical and analytical researches in this subject. It is sought to obtain the pressure field of a stable vortex by optical registration, to evaluate anemometrically the field of the three components of motion, to investigate the kinematic, dynamic, acceleration and energy relations, and to deduce the rôle of the energy in the three parts of the vortex, core, intermediate and outer layers, from measurements which were confirmed experimentally. The assumptions often made, that a vortex consists of a rotating core which has set the surrounding air into a circular potential movement is shown to be misleading because the core of a vortex must be conceived as the passive part and it is not able to direct or transfer any quantity of energy worth mentioning. The successive stages in the formation of an atmospheric vortex are then set out in detail. The application of these results to the domain of physics and geophysics leads in many ways to changes in our assumptions regarding the occurrence and method of action of real vortices, but this part is to be treated in a later paper.
R. S. R.

4005. Intrusion of Air into Anticyclones. C. S. Durst. *Roy. Meteorolog. Soc., J.* 59. *pp.* 231–234; *Disc.*, 234–237, *July*, 1933.—The equations of motion of a rotating fluid on a rotating globe are examined. This examination shows that in conditions which remain constant for a considerable period the descent of air in an anticyclone is associated with an inflow towards the centre of the right order of magnitude to balance the outflow near the surface. Observations taken during three anticyclones are examined in support of the theory. The author also points out that this theory affords an explanation of the empirical forecasting rule that warm-cored anticyclones are likely to endure. In the *Discussion*, Members of the

Society, while agreeing with the author on certain points, desired to point out that in the actual atmosphere conditions are different from an exact mathematical problem, in particular with regard to the wind velocity being assumed constant all round the centre; also as regards the assumption of steady motion, some idea of the underlying physical process is desirable. The author in reply admitted that more data are desirable for a further test of the theory, but as regards steady motion he considered this to be fairly well justified in the type examined. A. E. M. G.

4006. Kinematical and Dynamical Properties of the Field of Pressure with Application to Weather Forecasting. S. Petterssen. *Geofysiske Publ.* 10. 2. [92 *pp.*], 1933. *In English.*—This memoir consists of a short introduction in which are set forth briefly its main objects, together with seven chapters. Chapter I contains the definitions of characteristic curves in the field of pressure. The velocity and acceleration of these curves are also defined, while equations are established whereby the values of these quantities may be obtained. Applications of these equations are found in the next four chapters. Chapter II discusses the displacement of isobars and isallobars, Chapter III the movement of troughs and wedges, Chapter IV that of pressure systems. The movement of fronts is dealt with at considerable length in Chapter V. Four types of front in particular are investigated, and the components of the acceleration in each case are given in tabular form. Consideration is given to the question of the diminution or the increase of the intensities of the fronts, and also to that of the distribution of the vertical velocity in the vicinity of the fronts. The processes of deepening and filling of the systems discussed in the previous chapters are dealt with in Chapter VI. Chapter VII is reserved for a discussion of the application to weather charts of the formulæ developed in the preceding chapters, "to give an idea of the average accuracy which can be obtained by numerical methods." The method is applied to actual examples of all types of distribution mentioned in the previous chapters. In consequence the author concludes that this process of forecasting could have been used in every case with advantage, in particular in the case of the hurricane centre of October 22, 1921. Examples of the increase or the decrease of front intensity are also discussed and likewise the relation of isallobaric gradient and precipitation. A. E. M. G.

4007. Long-Period Weather Forecasting. S. Evjen. *Geofysiske Publ.* 10. 3. [14 *pp.*], 1933.—The author gives the results of a series of tests regarding forecasts of weather in N. Norway. Barometric changes, mainly, are used and as the procedure is similar to that used by Krogness in his temperature curves the latter's results are first described. The author obtained a series of 6-day pressure differences for the following places: Spitzbergen, Jan Mayen, Vardö, Röst, Lister, Stornoway, Valentia and Croydon and the curves of differences extend over 10 years. The relations found are more difficult to apply in summer than in winter because the disturbances are smaller. The following rules were found to hold: (1) the weather is swayed by periods of 14 and 27 days, one half of the period giving fire and the other half bad weather; (2) if the charts of barometric disturbances show large values, then the curves for stations near the centre will show long periods, while with more powerful disturbances over a large region mostly long periods will occur; (3) if the centre of disturbances remains stationary and also decreases in intensity, one can assume it will regenerate and produce changeable weather. The application of these rules is discussed in relation to changes in weather during the 10 years examined. R. S. R.

4008. Size of Dust Particles in Air. J. Pfaff. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 236–239, 1933.—The numbers of dust particles in the air at Saarbrücken have been counted at various times and places and under various meteorological conditions, and the connection between the numbers and such conditions discussed. The numbers vary from 160 to 2000 per cc. (but must be reduced by about 15 % by reason of diffraction effects in the method of counting). The predominant size is 0·25–0·75 μ, though there are some larger particles (1–5 μ), usually about 10 %, though sometimes as much as 50 %, larger. C. A. S.

4009. Diurnal Variation of Free Air Temperature and of the Temperature Lapse Rate. J. C. Ballard. *Monthly Weather Rev.* 61. *pp.* 61–80, *March,* 1933.—The principal facts operating to produce temperature changes at the surface and in the free air are stated and their modes of operation explained. These include (1) solar radiation, (2) reradiation between the ground, clouds and atmosphere, (3) vertical convection, (4) changes of phase of water, (5) advection, and (6) conduction. The effect on diurnal temperature range is discussed from the effects of water vapour, nature of surface, mean air displacement, hours of sunshine and minor factors. The data were obtained from numerous kite ascents at six aerological stations in U.S.A. using a Marvin-Hargrave kite and attempting to get two series of ascents each month with 7 to 9 ascents in 24 hours in each series. The results are smoothed and arranged according to stations and levels. The more important conclusions drawn from a discussion of the smoothed data include (1) diurnal temperature variation with a single period exists up to an altitude of about 1000 m. from the ground, the magnitude decreasing rapidly with height near the ground and then less rapidly; above 2000 m. the variation is doubtful and above 1000 m. it is generally below 1° C.; (2) the times of diurnal maximum and minimum occur later in the day with increasing altitude above the surface; (3) the lapse rate has a regular diurnal period over the range in altitude over which a definite period exists. Similar studies of diurnal variation of relative humidity, vapour pressure, and wind are to be given later. R. S. R.

4010. Extremes of Cold and Warm Summers and Winters during the Ice Age. R. Spitaler. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 300–315, 1933.—In the present paper the author obtains more exact dates for the summer and winter temperatures for latitudes 40°, 50° and 60° N. in order to get a more logical order for the ice ages and the temperature conditions than is given in earlier papers. For a period of 1,403,230 years there are tabulated the intervals of time between successive perihelion (Π) of 90° and 270°, eccentricity (e) and the mean summer and winter temperatures of these three latitudes. The table shows the increase of temperature difference from summer to winter between $\Pi = 90°$ and 270° with e increasing from 0·00 to 0·07. Corresponding values are then calculated for $\Pi = 135°$ and 315°. To get e for the limit of ice or interglacial times it is found that if the summer temperature of mid May and June or August and September falls, and then again still further, glaciation begins. This limiting temperature is approximately equal to that for $\Pi = 270°$ and $e = 0{\cdot}035$. These summer temperatures are shown in thick type in the table. The theory given is opposed to the views of Croll that the change is due to variations of perihelion. [See Abstracts 2289 (1933) and 4839 (1932).] R. S. R.

4011. Mean Temperature of the Two Hemispheres of the Earth. R. Spitaler. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 316–319, 1933.—The mean temperatures of 5° zones of latitude are obtained from observed values and calculated from a formula $t_\varphi = Ln + W(1 - n)$, where L and W are temperatures over land and sea and n and $(1 - n)$ the fractions for land and water of the total surface. By summation the mean temperatures of the two hemispheres and of the whole earth are obtained and tabulated for January, July, year, and mean of January and July. The mean temperature of the year and the mean of January and July are both 1·9° C. higher in the N. than in the S. hemisphere, this being due to the larger proportion of land. For the N. hemisphere the influence of land is greater in January than in July or for the year, probably due to the ice in the polar seas, but the difference is much less in the S. hemisphere. Also the mean land covering (n) is found to be 0·427 for the N. hemisphere and 0·140 for the S. hemisphere. R. S. R.

4012. 27-Day Period of Halo Frequency. G. Archenhold. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 141–143, 1933.—For the period 1926–31, 355 observations of solar haloes were made at Berlin-Treptow and a few also at Usedom and in the Tyrol. For all cases the number of occasions with haloes occurring 1 to 5 and 23 to 32 days later were determined. The tabulated values indicate a maximum recurrence 26 or 28 days later for each year, while the mean value indicates a maximum frequency 27 days later, agreeing with the period of 27·3 days for the sun's rotation. The observations were made during a period of maximum solar activity. The results indicate that the years of maximum sunspot frequency are more favourable than the years of minimum for the occurrence of the 27-day period for haloes. The probability of an accidental relationship is found to be very small. R. S. R.

4013. Photoelectric Measurement of Sky Polarisation. Z. Sekera. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 285–299, 1933.—Zenithal measurements were made at Ondřejov, Bohemia, during August and September, 1932, using a cuprous oxide photoelectric cell, Tungsram S. 631. This is especially suitable because of its straight-line characteristic and great sensitivity and the current can be measured directly with a galvanometer. The intensities of the components i and i_1, in and perpendicular, respectively, to the plane of polarisation were measured by Dorno's method, using only a Nicol prism and the photoelectric cell. The total intensity $i_g = i_1 + i$, the intensity of the polarised part, $i_p = i_1 - i$, and the polarisation $P = (i_1 - i)/(i_1 + i)$ were calculated. Records for two almost cloudless days giving intensities as functions of zenithal distances (z) from the sun agree with results obtained from other workers. Except near the zenith Schembor's equation $\log i_g = a + b \sin^2 z$ was confirmed. Values found for P are smaller than those from visual methods. The variation of the values before sunset differs considerably from earlier results but a maximum is found for $z = 93 \cdot 4°$ and a sharp decrease immediately after. Finally, the accuracy of the measurements and the advantages and disadvantages of the method are discussed. R. S. R.

4014. Transmission of Light through Fog. F. Born, W. Dziobek and M. Wolff. *Zeits. f. techn. Physik*, 14. 7. *pp.* 289–293, 1933. *From the Reichsanstalt.*—From measurements of the apparent colour temperature of an opal glass plate when seen through fog and through clear air, the spectral transmission of the fog can be determined in the visible spectral region. From this the effect on the contrast of a test object when seen through fog is determined. Measurements with artificial fog with as much as 60 % absorption produce no real changes in the apparent colour temperature of the opal glass ; with denser fog an increase in the apparent temperature is produced. Details of a suitable apparatus for the measurements, with some experimental results, are described. W. D. W.

4015. New Proof of the Hydrodynamic Circulation Theorem. H. Ertel. *Preuss. Akad. Wiss. Berlin, Ber.* 11. *pp.* 447–449, 1933.—The author refers to Bjerknes theorem on circulation relative to the earth, which is one of the most important in meteorology and oceanography,

$$\frac{d}{dt}\int v_j\,dx_j + 2\,w\,\frac{dS}{dt} = -\int a\,\frac{\partial p}{\partial x_j}\,.\,dx_j$$

The proof hitherto given for the second term involves a detailed transformation, but the author gives a mathematical proof which is explicit. This is obtained by using, instead of the hydrodynamical equations of motion in the Eulerian form, the Lagrangian equations of the second kind, from which the Eulerian equations are given. R. S. R.

4016. Variation Principle of Atmospheric Dynamics. H. Ertel. *Preuss. Akad. Wiss. Berlin, Ber.* 12. *pp.* 461–464, 1933.—The author seeks to derive this principle for atmospheric motion by an extension of the Hamilton principle of stationary action. A function L is sought for which over the time t_2-t_1 the integral $\int_{t_1}^{t_2} L\,dt$ reaches an extreme value, and from this the equations of atmospheric motion can be set out in the Eulerian form for adiabatic and isothermal changes. The principle of stationary action in the form of derived equations for isothermal and adiabatic motion indicates that the atmospheric motion, adiabatic or isothermal, when estimated by a system of coordinates connected with the rotating earth, proceeds in such a way that the time integral of the expanded Lagrangian functions $L_T = E_{kin} + wD_w - (E_{pot} + \Phi_T)$ and $L_s = E_{kin} + w\,D_w - (E_{pot} + \Phi_s)$ reach a minimum. It is shown that Raethjen's application of this principle to the meteorological problems of squalls in a simple way can be completed. R. S. R.

See also Abstracts 3991, 4020, 4180.

SEISMOLOGY.

4017. Analysis of Rayleigh Waves. H. and (Mme) Y. Labrouste. *Comptes Rendus*, 197. *pp.* 176–177, *July* 10, 1933.—The long waves on seismograms used to record vertical earth movements deal with Rayleigh waves only and not with superficial waves such as Love waves. These give oscillations of decreasing period from the start of the trace and appear to be composed of an infinite number of periods leading to a dispersion curve where the speed of propagation is a function of the corresponding pseudo periods. The Formosa earthquake of Sept. 1st, 1922, has been analysed in this way for a train of waves from the Abisko seismogram and it leads to a new interpretation of Rayleigh waves. By interference of elementary trains of waves the variations in amplitude in the earliest part of the trace are explained. The three most important periods are 25·5, 19·5 and 14·5 seconds, and there are others of feebler amplitudes. Superposition of these waves leads to a very faithful reproduction of the original seismogram. R. S. R.

4018. Periodic Components in Love Waves. (Mme) Y. Labrouste. *Comptes Rendus*, 197. *pp.* 344–346, *July* 24, 1933.—The author gives a graph of the Abisko seismogram (G) studied earlier [see preceding Abstract] and of four components with important and four with lesser amplitude which when combined reproduce the curve G satisfactorily. The periods and speeds of these component trains of waves are calculated and tabulated. A number of other seismograms for this same earthquake recorded at stations other than Abisko were analysed similarly and they give approximately the same periods and speeds as for Abisko, although the results are less close on account of the feeble amplitude on the Abisko seismogram. R. S. R.

4019. Earthquake Waves. Part IX. Sheltering Action of Earth's Core for Seismic Space Waves. H. Jung. *Göttingen Nachrichten, Math. Phys. Klasse, No.* 1. *pp.* 42–80, 1933.—The velocity of longitudinal and transverse seismic waves can be found from the time curves especially by Wiechert and Helglotz's integration procedure if certain assumptions are fulfilled. This holds for seismic waves for distances up to 105°, and velocities are found to a depth of about 2900 km. The amplitude of P waves becomes very weak for distances between 105° and 143° and then increases strongly, probably due to refraction of the waves in the earth's core, and the direct method of finding the velocity breaks down. The conditions for the occurrence of core sheltering action are investigated exhaustively, and it is found to occur not only with a rapidly decreasing velocity, but also with a steady decrease of velocity as soon as this exceeds in each concrete case a specified amount ($dv/dr > v/r$). Thus it is concluded that sheltering occurs if at the core boundary the velocity decreases at least 0·4 km./sec. at 100 km. The breakdown of the procedure for calculating velocity is overcome by assuming that the axis of the rays which penetrate the core possesses a constant curvature along the whole path in the core. The slope of this curve and also the time curve are used, and a test on these lines has been undertaken using Macelwaine's time curves of earthquakes, the P_1^1 and P_2^1 time curves, monographs of large scale earthquakes, and a large number of Göttingen seismograms of distant earthquakes. For distances >170° Spanish and Portuguese observations of New Zealand earthquakes were used. The results are shown to be analogous to the propagation of sound waves and electric waves in the atmosphere with their corresponding zones of silence. R. S. R.

TERRESTRIAL ELECTRICITY AND MAGNETISM.

4020. Electric Potential Gradient and Atmospheric Pressure. R. Guizonnier. *Comptes Rendus*, 197. *pp.* 265–266, *July* 17, 1933.—From hourly values of electric potential gradient the diurnal mean values have been obtained for Batavia and Val Joyeux, Paris, and these values compared with curves of mean atmospheric pressure. Smoothed curves show that maxima and minima of the two elements agree in phase both for diurnal and annual mean values. The results were worked out also for Ebre and Samoa for 3 to 6 consecutive years. It is shown that Val Joyeux,

Ebre and Batavia have a maximum in December-January and a minimum in June-July, while for Samoa the maximum is in July and the minimum in January. For Val Joyeux and Ebre the corresponding mean yearly amplitudes are 14·3 volts for potential gradient and 2·2 mm. for pressure.
R. S. R.

4021. New Theory of Magnetic Storms. S. Chapman and V. C. A. Ferraro. *Terr. Mag.* 37. *pp.* 421–429, *Dec.*, 1932, *and* 38. *pp.* 79–96, *June*, 1933.—The development of the theory of a stream of corpuscles from the sun, detailed in previous papers [see Abstract 4500 (1932)] is continued, and the conditions in the gas at the head of the stream, as regards pressure, density and temperature, are examined. Of the total kinetic energy transformed during the advance of the stream into the earth's magnetic field, a large proportion is turned into heat energy, and the compressed stream may lose this heat by radiation or ionisation. Estimates show that the radiation seems insufficient to prevent the gas rising above 6000°. In Part II, which deals with the main phase of the magnetic storm, the authors investigate a mechanism by which a current ring of ions and electrons might be formed round the earth, and the conditions of equilibrium and stability of such a ring. A ring which would decrease the earth's field by an amount comparable with that observed during the main phase of a magnetic storm would persist unchanged for several days, provided the surface charges on the ring remained for as long a period, but the ring would tend to break up at a quicker rate through the action of escaping charges than by actual decay of the current. G. E. A.

4022. Total Intensity of the Earth's Magnetisation from the Time of Revolution of Slower Electrons. K. H. Stehberger. *Ann. d. Physik*, 17. 3. *pp.* 278–292, *June*, 1933.—The electronic tube possesses the advantage over other methods that the total intensity (F) of the magnetic field is determined, and not one component, and the value is approximately independent of the field direction and its variations. Further F is determined from fixed quantities for the electron, e, m, and w, its angular velocity, by the equation $F = w\,(1/e/m)$. The experimental arrangements are described which permit measurements of the time of revolution of the electron with an accuracy of 2 %. The value of F is independent of any variable properties of the measuring tube or other arrangements such as the constancy of the wave-length over longer times. A technical incompleteness arises from the necessarily high strength of the electronic stream which produces many disturbances and inconveniences in the handling of the apparatus. The various sources of error are investigated. The most important arises from the contact potential difference between the two boundary surfaces of the measuring space. Methods for their elimination are given. An experimental comparison with measurements of the horizontal intensity and inclination shows satisfactory agreement between the two methods.
R. S. R.

4023. Approximate Integration of the Equations of Motion of Electrons in the Field of a Magnetic Dipole. C. Störmer. *Zeits. f. Astrophysik*, 6. *pp.* 333–344, *June* 21, 1933.—The integrals of the equations of motion of an electron in the field of a magnetic dipole are shown to depend on known functions which can be expressed in terms of elliptic functions and integrals. Approximate formulæ are thus obtained for the electron paths.
A. W.

4024. Application of Liouville's Theorem to Electron Orbits in the Earth's Magnetic Field. W. F. G. Swann. *Phys. Rev.* **44.** *pp.* **224–227,** *Aug.* **1, 1933.**—It is pointed out that in the application of Liouville's theorem to the problem of cosmic-ray intensities, Lemaître and Vallarta have implicitly taken the electron momentum as that corresponding to a free particle. Calling this momentum p' the particle momentum, it must be realised that Liouville's theorem is usually based upon the Hamiltonian equations in which the momentum p associated with an electron is not the same as p', but is connected with it by the relation $p=p'+eU/c$, where U is the vector potential determining the magnetic field. The Hamiltonian equations are not valid in terms of momenta of the type p', and, it is not, therefore, clear that Liouville's theorem is valid when expressed in terms of these momenta. The object of the paper is to show that a theorem the equivalent of Liouville's theorem is, in fact, true in terms of the coordinates and the momenta p', so that the ultimate validity of the use of the theorem by Lemaître and Vallarta is substantiated. It is to be observed, moreover, that the validity of this extended form of Liouville's theorem is true even in the presence of an electric field. AUTHOR.

4025. Diurnal Incidence of Disturbance in the Terrestrial Magnetic Field. A. C. Mitchell. *Roy. Soc. Edinburgh, Trans.* **57.** *pp.* **617–632, 1932–1933.**—The magnetic activity is estimated from the hourly ranges of the force components as recorded at Eskdalemuir from 1 Jan. 1914, to 31 Dec. 1925. The daily values of $\bar{A}$, the daily mean activity, for the twelve years ranged from 47 to 10,155, with a mean value 505, and $\bar{A}$ is subject to a seasonal variation from a winter minimum of 400 to an equinoctial maximum about 600. The general course of the diurnal variation of activity consists of a steady fall from midnight to a principal minimum about 6½ h., a rise to a secondary maximum about 15½ h., a secondary minimum at 19 h. and a principal maximum about 21½ h. For a given range of values of $\bar{A}$ the time of principal or morning minimum varies with the season of the year, and closer examination elicits that the time of minimum precedes the time of local sunrise by about 70 min. at midwinter and about 150 min. at midsummer. Assuming that the minimum marks the onset of activity due to currents in an overhead layer of atmosphere ionised by ultra-violet rays from the sun, the mean height of the layer is calculated at 213 m. with maxima about the two equinoxes. It is supposed that the regular diurnal changes in the force components are due to tidal action in a conducting atmospheric layer, and that the larger magnetic disturbances are due to the absorption by the atmosphere of electrified particles emitted by the sun, also that these two processes take place at different levels in the atmosphere. This is supported by recent measurements of the height of reflection of electromagnetic waves. As a consequence the phases of the two resulting changes in the terrestrial magnetic field must differ by nearly twelve hours, the first with a maximum about noon and the second about midnight. Further, the onset of the disturbance due to the first must vary in position with the season of the year. The results detailed are in general agreement with this theory. G. E. A.

See also Abstract 4001.

RADIOACTIVITY.

4026. Radioactivity of Potassium. D. Bocciarelli. *Accad. Lincei, Atti,* 17. *pp.* 830–836, *May* 21, 1933.—By means of measurements of absorption precise indications were obtained on the nature of the various components of the radiation from potassium. A first series of measurements was carried out by the method of coincidences between the impulses of two Geiger-Müller counters. A second series was undertaken to study the harder residual radiation. An absorption curve was obtained, which is given in the paper. It is concluded from the results of these absorption measurements, in agreement with the preceding measurements of magnetic deflection made by the author, and with the experiments of Kolhörster, that the radiation from K contains (1) a relatively soft β-component of velocity $0 \cdot 83\, c$ constituting about 60 % of the total intensity; (2) a harder β-component of velocity $0 \cdot 93\, c$ constituting almost the whole of the remaining intensity; (3) a very hard γ-component having an intensity equal to about 1·08 % of that of the complex radiation. J. J. S.

4027. Radioactivity of Rare Earth Elements. W. Yeh. *Comptes Rendus,* 197. *pp.* 142–143, *July* 10, 1933.—The oxalates of lanthanum, neodymium and samarium were examined by means of a Geiger-Müller counter. Slight emission (about 1/15th that from samarium) was indicated by neodymium, but lanthanum was entirely inactive. [See Abstract 2316 (1933).] C. A. S.

4028. Mesothorium II, Element 87. G. Guében. *Ann. Soc. Sci. de Bruxelles,* 53. *pp.* 115–118, *June* 24, 1933.—The author seeks to confirm the results obtained earlier [see Abstract 4369 (1932)] regarding the emission of α-rays by MsTh II. Two methods were employed, one similar to that of Geiger and Nuttall which showed three groups of transmissions from fresh MsTh II, but the results were only approximate. In a modification of Rutherford's method for precise determinations a double ionisation chamber was used with an amplifier and oscillograph. Three groups of α-particles were found corresponding to lengths of 4·37, 3·96 and 3·03 cm., and attributable respectively to RaTh, ThX and MsTh II. This was confirmed also by an old preparation of MsTh II. As with other radioactive elements a bifurcation occurs in the disintegration of MsTh II with a ratio for the two paths between 10^{-6} and 10^{-10}. The emission of an α-particle by an atom of MsTh II leads to an isotope of the element 87, which, as a consequence, becomes a member of the thorium family. R. S. R.

4029. Radium Solutions. A. Becker. *Zeits. f. Physik,* 83. 11–12. *pp.* 701–710, *July* 8, 1933.—The paper gives the results of measurements carried out to test the stability of radium solutions, some of which were prepared 18 years ago. Solutions not frequently used for standardising purposes are stable, but frequent use causes a decrease in the amount of emanation yielded by the solution. The presence of a very small quantity of sulphate or carbonate decreases the yield of emanation, the decrease depending on the amount of sulphate or carbonate present and on the period between the addition of the sulphate or carbonate and the measurement of the emanation. W. E. P.

4030. Collisions of α-Particles with Fluorine Nuclei. N. Feather. *Roy. Soc., Proc.* 141. *pp.* 194–209, *July* 3, 1933.—Stereoscopic photographs have been taken of the tracks of nearly half-a-million α-particles in a mixture of carbon tetrafluoride and helium. The source (thorium B + C + C′) was placed outside the expansion chamber, with the result that the initial 1·5 cm. air equivalent range of each group of particles was not observable. Over the remaining portion of path no proton disintegration was obtained. The range-velocity curve for fluorine recoil atoms has been constructed from stereo-reprojection measurements on 63 selected collision photographs, check measurements being similarly made for five close collisions with helium nuclei and one with the nucleus of a hydrogen atom. From the main data eight cases were excluded as probably referring to collisions with carbon nuclei ; from these some information concerning the form of the corresponding range-velocity curve has been obtained. A comparison is finally made with previous results, and reproductions of a number of collision photographs are appended. AUTHOR.

4031. Retardation of α-Particles in Hydrogen. G. Mano. *Comptes Rendus,* 197. *pp.* 47–49, *July* 3, 1933.—The velocities of slower α-particles [see Abstract 3313 (1932)] (with initial velocities of $2{\cdot}054-1{\cdot}420 \times 10^9$ cm./sec.) from Th (C + C′) after passage through varying distances (up to 12 cm.) in hydrogen at normal temperature and pressure have been determined. The results agree well with those deduced from Bethe's formula as revised by Bloch [see Abstract 2045 (1933)] if $\overline{E}$, the mean energy of excitation, be taken as 16·0 volts. C. A. S.

4032. Destruction of Zinc-Sulphide Phosphors by α-Rays. P. M. Wolf and N. Riehl. *Ann. d. Physik,* 17. 5. *pp.* 581–586, *July,* 1933.—A new explanation of the ageing of ZnS is given. It is attributed to the presence of free Zn atoms caused by the decomposition of ZnS by α-particles. A part of the excitation energy is transferred to these Zn atoms by collisions of the second kind, and is thereby converted into heat. The process is analogous to the extinction of the fluorescence of a gas by admixture of an impurity. This mechanism may be applied to explain why the phosphorescence of ZnS decays more quickly than the fluorescence. The experimental results of Berndt are shown to be in agreement with the author's suggestions. [See also Abstract 492 (1932) and the following Abstract.] W. E. P.

4033. Temperature-Dependence of the Scintillation Process and the Destruction of Phosphors. N. Riehl. *Ann. d. Physik,* 17. 5. *pp.* 587–592, *July,* 1933.—The variation with temperature of the luminosity excited by α-rays in ZnS was investigated over the range − 250°C. to + 600°C. Between − 250°C. and + 200°C. the luminosity is constant. At about 200°C. the luminosity suddenly decreases and at 500°C. disappears completely. The behaviour is similar in the case of excitation by light and by breaking up the crystals. The independence of the luminosity and the temperature between − 250°C. and + 200°C. is, in the case of excitation by α-rays, attributed to a secondary action of the α-rays, the existence of this action being proved experimentally. An explanation of the destruction and luminosity of phosphors, based on the dependence of the luminosity on temperature, is developed. [See preceding Abstract.] W. E. P.

4034. Investigation of the Radiations from RaD, Using the Wilson Method. G. v. Droste. *Zeits. f. Physik,* 84. 1–2. *pp.* 17–41, *July* 17, 1933.—By the Wilson method some 1200 photographs were obtained of the secondary β-rays set free in air, CO_2 and A by the radiations from RaD. Vapour of ethyl alcohol gave better photographs than water vapour. About 500 tracks were measured. Besides recoil and photoelectrons due to the γ-ray line 261, photoelectrons occur due to the L-radiation which is liberated by the internal absorption of the γ-ray line. The average ranges of the 3 observed groups of electrons were 1·25, 36·2 and 3·1 mm., corresponding to the recoil and photoelectrons of the γ-ray line and the photoelectrons from the Bi L-radiation respectively. A curve was obtained between range and energy of the γ-rays from 0 to 50 ekV. The efficiency of internal conversions was estimated at 3·6 %. F. C. C.

4035. γ-Ray and X-Ray Spectra of the Radium Family. M. Valadares. *Comptes Rendus,* 197. *pp.* 144–146, *July* 10, 1933.—Determined as previously [see Abstract 2328 (1933)], but corrected by using also 2nd and 3rd order spectra, and as regards 160·7 and 165·8X by their comparative absorption by iridium, the strong lines 138·9, 143·0, 160·7 and 165·8X of Ra(B + C) agree well with the K lines of bismuth experimentally determined, and with those calculated from the energies of the electronic levels of element 83. They are therefore lines of fluorescence, as also are probably the weak lines found in this region. The line at 332·7X is possibly identical with Ellis and Skinner's line, 53·6 kV of Ra(B + C) [see Abstracts 1206 (1924) and 554 and 1927 (1933)]. C. A. S.

4036. Comparison of the Nuclear Theories of Heisenberg and Wigner. Part I. C. Eckart. *Phys. Rev.* 44. *pp.* 109–111, *July* 15, 1933.—The energy levels of Wigner's proposed equation [see Abstract 1673 (1933)] for protons and neutrons in nuclei are compared with those of Heisenberg's equation [see Abstract 1842 (1933)] after the latter has been simplified by the omission of all interaction terms except those between protons and neutrons. It is assumed for the purpose of comparison, that Wigner's potential energy function is identical with Heisenberg's exchange energy $-J$. It is shown that the lowest energy level of Wigner's equation must be lower (more stable) than the lowest level of Heisenberg's equation, except in the case of H^2, for which they are the same. This does not exclude the possibility that Heisenberg's equation may give as good a value for the ratio of the mass defects of He^4 and H^2 as Wigner's equation, since the assumption above is not necessary except for the statement of the theorem. It is also shown that Heisenberg's equation probably predicts that the nuclei H^3 and He^3 are unstable. AUTHOR.

4037. E.H.T. Production for Artificial Disintegration of Atomic Nuclei. J. M. Ledeboer. *Physica,* 13*e*. 5. *pp.* 145–170, 1933.—A survey is given of the different methods used to generate the extremely high potentials necessary for the experimental study of nuclear structure. AUTHOR.

4038. Atomic Nucleus and High Voltages. M. A. Tuve. *Frank. Inst., J.* 216. *pp.* 1–38, *July,* 1933.—A detailed account of methods and results obtained in the field of artificial disintegration of atomic nuclei.

4039. Positive Electrons Produced in Disintegrations. Irène Curie and F. Joliot. *Comptes Rendus*, 196. *pp.* 1885–1887, *June* 19, 1933.—In a previous paper [see Abstracts 2919 and 3473 (1933)] the authors have shown that high energied photons can produce positive electrons by collisions with atomic nuclei. In the present paper it is shown that positive electrons may also be produced during the artificial disintegration of elements such as aluminium or boron. Electrons emitted during the disintegration of aluminium with α-particles from polonium have an energy less than $1\cdot6\times10^6$ electron volts with a few having an energy of 2–3×10^6 electron volts. The positive electrons appear to be emitted as freely in the backward direction as in the forward. The effect is ascribed to the possibility that occasionally in a disintegration a neutron + positive electron is emitted in place of the usual proton.
J. E. R. C.

4040. Emission of Neutrons. Irène Curie and F. Joliot. *J. de Physique et le Radium*, 4. *pp.* 278–286, *June*, 1933.—It is shown that F, Na and Al emit neutrons and γ-radiation when bombarded by α-particles from polonium while no radiation was observable from H, C, O, N, P and Ca. The emission of neutrons by the first three elements, which can also emit protons, indicates that they can disintegrate in two ways. The variation of neutron emission with the energy of the α-particles is investigated and resonance levels are detected in Be and B, the former at $2\cdot6\times10^6$ electron volts and the latter at $2\cdot2\times10^6$ electron volts. Emission of neutrons by lithium commences at an α-particle energy of 5×10^6 electron volts while the γ-radiation commences at 3×10^6 electron volts, and it is suggested that the latter process corresponds to an excitation of the nucleus without α-particle capture. An indication of the minimum α-particle energy necessary to cause neutron emission from F and Al has been obtained and in each case the existence of resonance levels is necessary to explain the results.
J. E. R. C.

4041. Scattering of Neutrons and Protons. E. Wigner. *Zeits. f. Physik*, 83. 3–4. *pp.* 253–258, *June* 14, 1933.—A wave-mechanical treatment of the scattering of neutrons and protons is given. The calculations are linked up with the mass defect of the Urey hydrogen.
J. E. R. C.

4042. Transmutation of Elements by Protons. M. L. E. Oliphant and (Lord) Rutherford. *Roy. Soc., Proc.* 141. *pp.* 259–281, *July* 3, 1933.—The experiments of Cockcroft and Walton showed that artificial disintegration due to proton bombardment could be observed with comparatively low accelerating potentials. The present paper concerns experiments with low energied protons ($<$250 kV), but with large current densities (up to 100 μA). A detailed description is given of the discharge tube and a novel voltage measuring device. The following elements were subjected to the bombardment: Li, B, Fe, O, Na, Al, N, Be, F, Au, Pb, Bi, Tl, U, and Th. Disintegration particles were observed with B when the incident protons had energies of only 60,000 e.v., whilst with lithium the energy could be as low as 30,000 e.v. A detailed discussion of the disintegration of B^{11} is given and it is shown that an energy emission of 9×10^6 e.v. would be expected.
J. E. R. C.

4043. Artificial Disintegration of Aluminium. O. Haxel. *Zeits. f. Physik*, 83. 5–6. *pp.* 323–337, *June* 20, 1933.—Using α-particles with ranges from $4\cdot6$ to $8\cdot6$ cm. the dependence of the proton emission from aluminium upon the energy of the incident α-particle has been investigated using a multiplication counter. The counter was relatively insensitive to the β- and α-radiations, and the counting of the protons was automatic. Two groups of protons were observed, and their ranges were observed to increase with increasing α-particle energy. The energy changes observed agree with those given by Chadwick and Constable [see Abstract 2889 (1932)]. It appears that α-particles with a range of 8·6 cm. cause the emission of a third group of protons of short range with an energy loss of about 2×10^6 electron volts and this is ascribed to a new process. The resolution of the apparatus was insufficient to detect any fine structure in the groups. J. E. R. C.

4044. Artificial Disintegration of the Nitrogen Nucleus. E. C. Pollard. *Roy. Soc., Proc.* 141. *pp.* 375–385, *Aug.* 1, 1933.—Experiments to determine the manner of entry of the α-particle into the nitrogen nucleus are made; these indicate that entry is in general over the top of the barrier and the height of this barrier is fixed as between 4·1 and $4 \cdot 4 \times 10^6$ electron volts. Further investigation of the absorption curve of the protons confirms the work of Steudel [see Abstract 4366 (1932)] on this element and gives an indication of a second group at 6·6 cm. range, due to resonance with an α-particle of 2·2 cm. range or $3 \cdot 5 \times 10^6$ electron volts energy. AUTHOR.

4045. Application of the FP-54 Pliotron to Atomic Disintegration-Studies. L. R. Hafstad. *Phys. Rev.* 44. *pp.* 201–213, *Aug.* 1, 1933.—The possibility of utilising the high inherent sensitivity of the FP-54 Pliotron in nuclear disintegration-studies, particularly in connection with the problem presented by the discrepancies in present experimental results on resonance-disintegration of Al, has been investigated. The usable sensitivity of the tube is found to be limited only by a residual fluctuation of about $\pm 3 \times 10^{-5}$ r.m.s. volt. A theoretical consideration shows that this fluctuation is of the order of magnitude to be expected from shot-effects and thermal effects in the grid-circuit. Preliminary observations on the disintegration of Al when using a thick target gave the following results. The yield was about 20 protons, of ranges between 30 and 50 cm. per 10^8 α-particles, in good agreement with the results of Pose. Groups with ranges of about 30 cm. and 60 cm. were found to show the abrupt drop in the absorption-curve characteristic of Pose's results. (The present series of observations failed for purely technical reasons to give a conclusive result in the range 45 to 50 cm.) A "differential" curve neglecting the smallest deflections gave a maximum in the region 45 to 50 cm., suggesting the presence of a strong group of about this range. A discussion of other discrepancies in experimental data on the basis of FP-54 results must await further observations with a more suitable α-particle source. AUTHOR.

See also Abstracts 3873, 3882, 4206, 4221, 4222, 4276.

RADIATION.

ABSORPTION AND TRANSMISSION.

4046. Ultra-Violet Transmission of Alkali-Beryllium-Borate Glasses. W. Ziegler and Marianne Wellmann. *Zeits. f. techn. Physik,* 14. 7. *pp.* 288–289, 1933.—The ultra-violet transmission of this type of glass, with particular reference to a lithium-beryllium-borate glass, is described, and photographs show that it will transmit practically down to 190 $\mu\mu$. It is claimed that the glass is readily obtained free from bubbles and is valuable as a satisfactory substitute for quartz. W. D. W.

4047. Comparison of the Transmission Bands of Metallic Silver and Colloidal Silver. P. Maréchal. *Comptes Rendus.* 196. *pp.* 1984–1985, *June* 26, 1933.—A photographic spectrophotometric method is used to compare the transmission of silver films sputtered on quartz with that of two different colloidal solutions of silver, the wave-length region investigated extending from 2600 to 3730 Å. The results in all cases are reduced to the same effective thickness of silver, and it is found that both the colloidal solutions have the same transmission and that this transmission is identical with that of the sputtered film. L. A. W.

See also Abstracts 4014, 4068, 4083.

ELECTRO-OPTICAL AND MAGNETO-OPTICAL EFFECTS.

4048. Kerr Effect and Association in Liquids. H. A. Stuart and H. Volkmann. *Zeits. f. Physik,* 83. 7–8. *pp.* 444–482, *June* 28, 1933.—In order to obtain the experimental basis necessary for a quantitative theory of the Kerr effect in liquids and thence to apply the Kerr effect to the problem of association, the dependence on temperature of the Kerr constants of C_6H_6, C_7H_{14} and CCl_4 has been measured by an absolute method. The molar Kerr constants of nitrobenzene in solution in these liquids have also been determined at various temperatures for various concentrations. The results and those of other authors are carefully compared with the Langevin-Born theory, and it is found that the observed values are 2 to 5·5 times smaller than those predicted theoretically. The divergence decreases with increasing temperature, and is attributed to the effect of association. This effect, which must thus be assumed to occur in non-polar liquids, is investigated further by a discussion of the effect of changes of density on molecular refraction and polarisation, and on the depolarisation of light scattered molecularly, particularly in the transition from the gaseous to the liquid state. In all cases, divergences from the molecular theory (strictly valid for gases only) only occur when the density is so great and thus the inter-molecular distances are so small, that a random orientation of the molecular axes becomes impossible on spatial grounds. The behaviour of the Kerr constant in liquids is then discussed from this viewpoint, and an extension of the theory by Raman and Krishnan is shown not to be in accordance with experiment. C. B. A.

4049. Abnormal Electric and Magnetic Birefringence. R. Lucas and M. Schwob. *J. de Physique et le Radium,* 4. *pp.* 287–300, *June,* 1933.—A collected account of work previously published, giving in detail the method used, the results obtained with fenchone, ethyl phenylsuccinate, and camphor, followed by a discussion showing the insufficiency of previous theories regarding the anomalies in dispersion, and that these are explicable on the assumption of the presence of two or more isomers of differing birefringences in dynamic equilibrium. [See Abstracts 2670 (1928), 4238 (1932), 2352 and 3490 (1933).] C. A. S.

4050. Magnetic Rotatory Power of Gases and Vapours. P. Gabiano. *Ann. de Physique*, 20. *pp.* 68–131, *July–Aug.*, 1933.—Previous results are shown to be often in disagreement while the experimental methods are of little general use. A large magnetic polarimeter is described by which measurements can be made on gases and vapours with a magnetic potential difference exceeding 10^6 c.g.s. units. Verdet's constant can thus be found to a high precision (1%–5%). Calculated results under normal conditions are given for H_2, CO_2, CO, N_2O, H_2S, $(CN)_2$, CS_2, CH_4, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, C_6H_{14}, C_2H_4, C_2H_2, CH_3Cl, C_2H_5Cl, C_3H_7Cl, CH_3Br, C_2H_5Br, C_3H_7Br, CH_3I, C_2H_5I and C_6H_6. The numbers obtained provide a means of calculating the specific magnetic rotatory power in the gaseous and liquid states. The molecular theory of the phenomenon leads to the specific rotatory power as a function of the refractive index of the liquid. Admitting explicitly Lorentz's value of the molecular field the relation is obtained $[\Lambda]_G/[\Lambda]_L = 9n_L/(n_L^2+2)^2$. The experimental agreement is very close but on the contrary it would be clearly in defect, if one expresses the molecular field by a different factor, especially Gladstone's. From a comparison of the molecular magnetic rotatory powers one can deduce specific values of the atomic rotations. In the case of H and C the experimental values agree well with the theoretical numbers calculated from the refringent powers. It is shown that the old values proposed by Perkins must be abandoned. The new values permit the calculation, *a priori* of the magnetic rotatory power of an organic substance whether in the gaseous or liquid state. R. S. R.

See also Abstract 4053.

FLUORESCENCE AND PHOSPHORESCENCE. LUMINESCENCE AND AFTERGLOW.

4051. Emission of Radiation by Chemical Reactions. R. Audubert and van Doormaal. *Comptes Rendus*, 196. *pp.* 1883–1885, *June* 19, 1933.—Using a Geiger-Müller counter with a photosensitive kathode it is possible to detect an emission of radiation from certain chemical reactions. The amount of the emission is quite small and appears to increase with the violence of the reactions. A rough estimate of the character of the radiation is made by using kathodes which are sensitive to different regions of the spectrum. J. E. R. C.

4052. Extinction of Fluorescence by Organic Substances. J. Eisenbrand. *Zeits. f. phys. Chem.* 22. *Abt.B.* 3. *pp.* 145–168, *July*, 1933. —(I) The extinction of the fluorescence of quinine sulphate in acid methyl alcohol solution on addition of pyrocatechol, resorcinol and hydroquinone is not markedly different when instead of the diphenols their ethers are used. Thus any extinction theory which requires the reducing properties of the OH groups in the phenols falls to the ground. (II) This fluorescence may also be prevented by hydrocarbons. It seems to be connected with not fully saturated conjugate double bonds. Benzene does not inhibit fluorescence, neither do hydrocarbons with only one single double-bond.

(III) The existence of extinguishing *derivatives* of benzene is to be understood as due to disturbance of the saturated conjugate system of benzene. Not all substituents lead to extinguishing derivatives. (IV) Extinction power is considered in relation to other physical properties—(*a*) absorption of light, (*b*) dipole moment, (*c*) molecular refraction, and (*d*) ionic charges. An increased molecular refraction goes with extinction-power, but not vice versa. (V) The extinguishing process is thought to be an induced effect produced by especially loosely-bound electrons. A. C. M.

4053. Effect of the Magnetic Field on the Fluorescence of a Stream of Cadmium Atoms : Lande Factor *g* for State 2^3P_1. P. Soleillet. *Comptes Rendus,* 197. *pp.* 46–47, *July,* 3 1933.—A horizontal beam of light of λ 3261, polarised vertically, was passed through a vertical stream of cadmium atoms at 600° Abs. A magnetic field of $0\cdot025$ gauss was applied perpendicularly to both beam and jet and the effect on the polarisation of the fluorescent light observed in the same direction. From the result, the Larmor rotation ω_0 being $3\cdot67\times10^5$, the Lande factor *g* was deduced as $1\cdot75$, agreeing within the limits of experimental error with the theoretical $1\cdot50$. C. A. S.

4054. Efficiency of the Chemiluminescence Accompanying Oxidation of Grignard Compounds. C. D. Thomas and R. T. Dufford. *J.O.S.A.* 23. *pp.* 251–255, *July,* 1933.—Solutions in ether of Grignard reagents exhibit chemiluminescence when the compounds are oxidised by oxygen, air, or certain other oxidising agents, and also, in what appears to be a different process, when the compounds react with chloropicrin or bromopicrin. These chemiluminescence spectra are single-banded. A quantitative study is made of the luminescence accompanying the reaction of the Grignard solutions with oxygen, and an attempt is made to determine the efficiency of the process. Two separate determinations are necessary ; (1) that of the total amount of energy released in oxidising a known amount of substance, (2) that of the energy equivalent of the total light emitted during this oxidation. The first determination is made calorimetrically, full details being given of the various necessary precautions. The second determination is made optically by means of a substitution method. The luminous efficiency as determined in this manner varies from 10^{-5}% to 10^{-7}% for the four brightest compounds investigated. A. H.

See also Abstracts 4032, 4033.

INTERFERENCE. DIFFRACTION AND SCATTERING.

4055. Astigmatism of the Concave Grating. G. H. Dieke. *J.O.S.A.* 23. *pp.* 274–281, *Aug.,* 1933.—For light of any given wavelength, the angle of incidence on a concave grating which gives minimum astigmatism has been calculated from the general expression for the astigmatism. To obtain the maximum efficiency with a Paschen mounting, the use of two fixed slits is suggested. For the lower orders an angle of incidence of about 13° is suitable. The astigmatism in the ultra-violet is then not harmful for most purposes. It is shown that the Rowland mounting is very inefficient as far as intensity losses by astigmatism are concerned, whereas the Eagle mounting represents very nearly the optimum condition. A method is suggested to make use of the astigmatism for intensity measurements. AUTHOR.

See also Abstracts 3912, 4127, 4200.

PHOTOCHEMISTRY (INCLUDING PHOTOGRAPHY).

4056. Latent Image and Physical Development. Part IV. H. Arens. *Zeits. f. wiss. Phot.* 32. *pp.* 65–75, *June*, 1933.—Gives further results regarding the relationship between the developed mass of silver and time. The relative growth velocity is defined as the silver mass developed in unit time on unit surface of the silver particles, whilst by absolute growth velocity is meant the silver mass developed in unit time over the whole surface of the particles. The relative growth velocity is found to be dependent on the condition of the developer, the size of the silver particles, and their concentration in the layer. It is found to decrease with increasing size of the particles, provided the number of particles per square cm. of the layer remains constant. With constancy of particle size, however, the relative growth velocity increases with decreasing concentration of the particles in the layer, and the absolute growth velocity increases at the commencement of development, later becoming approximately constant. The same mass of silver is developed in a given time if the same number of nuclei of size equal to or smaller than 10^{-15} gm. are available, the law only being fulfilled with long times of development. [See also Abstract 1857 (1933).] R. C. F.

4057. Theory of the Ideal Colour Sensitivity of Photographic Materials. J. E. de Langhe. *Zeits. f. wiss. Phot.* 32. *pp.* 76–82, *June*, 1933.—Develops a theory for the ideal colour sensitivity from a mathematical extension of the Goldberg law. The results obtained show that, fundamentally, the curves of log I against λ, for constant density, should be the inverse of the spectral sensitivity curves of the eye, the equation of the characteristic curve being derived. The curves of D against λ, on the other hand, should be proportional to the spectral sensitivity curves of the eye. It is also shown that γ is proportional to the sensitivity of the eye, whilst the inertia does not depend upon the wave-length. R. C. F.

4058. Influence of Temperature on the Chromatic Sensitivity of Photographic Plates. (Miss) J. Clavier. *Comptes Rendus*, 197. *pp.* 235–236, *July* 17, 1933.—Results obtained with various types of plates when heated to temperatures between 30° and 100° C., and obtained for certain wave-lengths between 4000 Å and 7500 Å, show that such heating does increase sensitivity. In two types a maximum increase in sensitivity was obtained for 5500 Å and 60° C.; one type gave no such maximum, whilst others had either maxima at lower wave-lengths and higher temperatures, or the effect of heating was very pronounced, giving rise to a considerable reduction in exposure time. R. C. F.

4059. Influence of the Hydrogen-Ion Concentration on the Light Sensitivity of Gelatin-Free Silver Bromide. A. J. Rabinowitsch and C. S. Bagdassarjan. *Zeits. f. wiss. Phot.* 32. *pp.* 110–119, *July*, 1933.—As an extension of examinations which have shown that the sensitivity of silver bromide-gelatin emulsions increases with increasing alkalinity, the authors have examined, from the point of view of direct blackening, the influence of pH on the sensitivity of silver bromide without gelatin. It is shown qualitatively that with silver bromide suspensions there is a real increase in sensitivity with rise of pH values if the coagulation effect is excluded. From a quantitative estimation of the separated silver it is shown that the sensitivity of silver bromide precipitates rapidly increases for values of the pH greater than 7·5, whilst the excess of bromide ions reduces these effects as well as reducing the general sensitivity of silver bromide. The OH-ions produce a particularly strong effect in red light, indicating sensitisation in this region. Potentiometric curves show a weak adsorption of H-ions in acid solutions, and a strong adsorption of OH-ions in alkaline solutions, whilst they also show that Br-ions reduce the OH-ion adsorption, but favour that of the H-ions. Finally, it is shown that the increase in sensitivity of such gelatin-free silver bromides with increasing alkalinity, is due to the adsorption of OH-ions, and the action of these adsorbed ions is discussed. R. C. F.

4060. Schwarzschild Effect on Gelatin-Free Silver Bromide. A. J. Rabinowitsch and C. S. Bagdassarjan. *Zeits. f. wiss. Phot.* 32. *pp.* 110–112, *July,* 1933.—From an estimation of the Schwarzschild constant for gelatin-free silver bromides it is shown that the effect cannot be attributed to the emulsion as such, but is partially connected with the silver bromide itself. R. C. F.

4061. Conditions for Kinematograph Projection. J. Marette. *Soc. Franç. Phot. et Ciné., Bull.* 20. *pp.* 132–148, *June,* 1933.—Considers in turn the various matters which affect the clearness with which the projected picture is seen in a kinematograph theatre. The first of these is the contrast between the details of the picture as projected on the screen. This contrast is reduced by the presence of stray light and by the scattering of light in the beam, *e.g.*, by tobacco smoke. The sensitivity of the eye to contrast is next considered, and König's values of brightness-difference threshold at various intensities are tabulated. The conclusions reached as to the precautions which should be taken to ensure the best results are all concerned with the avoidance of stray or scattered light. The use of high-intensity lamps is also recommended. J. W. T. W.

4062. Simple Micro-Kinematograph. R. W. G. Wyckoff and J. B. Lagsdin. *Rev. Sci. Instruments,* 4. *pp.* 337–339, *June,* 1933.—A simple means of recording the growth of bacteria, etc., is described. It consists essentially of an optical bench carrying a kiné-camera, a light source, a microscope and the mechanism necessary to actuate these parts. The precautions necessary for the avoidance of vibration are given, whilst the most suitable types of camera and microscope are indicated. The exposure mechanism gives three exposures per minute. Under suitable temperature conditions no difficulty is experienced in maintaining the apparatus in focus over long periods. A. H.

4063. Phototechnical Properties of 32 Commercial Photographic Films. U. Schmieschek. *Zeits. f. techn. Physik,* 14. 7. *pp.* 284–288, 1933.—Describes results obtained from which data are derived regarding the four most important phototechnical properties of a number of commercial photographic films. The properties dealt with consist of general sensitivity, gradation, fog, and colour sensitivity, the results being given in tabular, and in certain cases, graphical form. Development times of 2, 4 and 8 min. were used in obtaining figures relating to gradation and fog. R. C. F.

4064. Photographic Plates for Use in Spectroscopy and Astronomy. C. E. K. Mees. *J.O.S.A.* 23. *pp.* 229–233, *July,* 1933.—Additional to the plates already described [see Abstract 3238 (1932)] a new emulsion (type V) is described which possesses a very small grain. The resolving

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power is thus very high, but the emulsion is so slow that it can only be used with certain types of panchromatic sensitisation. Slight alterations have also been made to certain of the sensitisations described earlier with a view to filling up gaps in the scheme. Three new sensitisings have been added for the visible, their maxima being at λ5900, λ6900 and λ7100. A new long range plate (type L) is sensitive from the ultra-violet up to λ9000. A new infra-red sensitisation (R) is added for the region λ7400–λ8400. Wedge spectrograms are given for the various emulsions described and a useful diagram summarising the plates available for the various parts of the whole spectral range from λ2700 to λ10,000 is also included. A. H.

PHOTOMETRY.

4065. Precision of Visual Photometry. Y. le Grand. *Rev. d'Optique*, 12. *pp.* 145–159, *April*, 1933.—By means of a special apparatus the author was able to measure the brightness difference threshold or differential sensitivity of the eye when viewing various commonly occurring photometric matching fields. The effects of a black line separating the areas to be compared, of variation in angular size of the whole field and its different parts, and of variation of the small added contrast in a contrast head, were all studied quantitatively. In a final section, the relation between the differential sensitivity and the probable error which will be made in a photometric setting is considered. The effects of a colour difference between the areas to be compared are definitely excluded from this investigation. W. S. S.

4066. Light Emission from Electric Spark. M. Kornetzki, V. Fomin and R. Steinitz. *Zeits. f. techn. Physik*, 14. 7. *pp.* 274–280, 1933.—Describes an extended series of measurements of the quantity of light (expressed in candle-seconds) emitted from a spark under various conditions. Since it was desired to measure the photographic rather than the visual effect a potassium photoelectric cell was used for the work. Spark voltages from 4 to 50 kV and capacities from 0·001 to 1μF were employed. The electrodes were of copper and a range of forms from a sharp point to a sphere of 29·5 mm. diameter were used. It was found that the former gave the most and the latter the least light. For both point and large sphere electrodes the light emitted varied as the 2·7 power of the voltage; for intermediate forms it varied as the 4th power. The relation between light emission and capacity was practically linear. The results are expressed to a fair approximation by the formula $H = aCV^n$, where H is the light emission in candle-seconds, C the capacity in μF, V the voltage in kV, n varies from 2·5 to 4 and a lies between 0·01 and 0·03. Experiments were also made to determine the duration of the spark under various conditions. J. W. T. W.

4067. Registering Microphotometer. W. Schütz. *Phys. Zeits.* 34. *pp.* 566–569, *July* 15, 1933.—Describes a new design of registering microphotometer which differs in some respects from the Koch microphotometer. The principle is explained by diagrams, and the constructional details are shown in photographs of the completed instrument. J. W. T. W.

See also Abstracts 4002, 4013, 4047, 4111, 4148.

POLARISATION.

4068. Optical Rotatory Power. Part IV. Rotatory Dispersion of Bornyl and Menthyl Xanthates, Especially in the Region of Absorption. T. M. Lowry and H. Hudson. *Roy. Soc., Phil. Trans.* **232.** *pp.* 117–154, *May* 30, 1933.—Measurements have been made of the absorption, circular dichroism, and rotatory dispersion of nine bornyl and menthyl xanthates and related compounds. The seven xanthates show two absorption bands, the weaker, at longer wave-lengths, being attributed to the –CS–S group, and the stronger, at short wave-lengths, to the > CS group. The "shapes" of these bands cannot be represented by the equations of Ketteler and Helmholtz, Bielecki and Henri, or Kuhn and Braun, but conform closely to a new equation which has been developed to express the fact that the bands are symmetrical on a scale of wave-lengths. The circular dichroism in the first band follows a similar course to the absorption, the "dissymmetry factor" $(\epsilon_r \sim \epsilon_l)/\epsilon$ being approximately proportional to the frequency. The circular dichroism of the second band is of opposite sign. The anomalous rotatory dispersion of the xanthates in the region of transparency can be expressed with great exactness by two terms of Drude's equation, *i.e.*, a l.f. term to represent the partial rotation of the first absorption band, and a h.f. term of opposite sign to represent the combined effect of the second band and of hypothetical bands in the Schumann region. The anomalies of the rotatory dispersion in the region of absorption cannot be expressed by the equations of Natanson, or of Kuhn and Braun, but have been represented in a more satisfactory manner by means of a new equation, corresponding with the new equations used to represent the absorption and circular dichrosim of the band. [ϵ_l and ϵ_r should be interchanged throughout the paper as requested by the authors.] C. B. A.

See also Abstract 4013.

RADIATION, EMISSION.

4069. Total Radiation from Oxide Kathodes. P. Clausing and J. B. Ludwig. *Physica,* 13*e*. 6. *pp.* 193–205, 1933. *In German.*—From the potential drop and current carried by a nickel tube coated with SrO or a mixture of SrO and BaO, the total energy radiated by the oxide surface *in vacuo* was determined. The temperature of the oxide surface was measured using an optical pyrometer, the necessary calibration being effected by raising the nickel tube with its covering to a uniform temperature and taking readings with the pyrometer sighted (*a*) on the oxide surface, (*b*) on the interior of the nickel tube seen through a small aperture. The radiation seen through the aperture could be taken as black-body radiation corresponding to the temperature of the oxide and tube. Plotting the total radiation emitted, against the temperature of the oxide surface, a straight line was obtained within the temperature range studied, 1000 to 1500°K. As the thickness of the oxide layer was increased from zero, the total radiation at a given temperature first increased, attained a maximum and then decreased to a value considerably lower than that for the bare nickel tube. An explanation of this behaviour is put forward, based on selective absorption and emission by thin oxide layers. The measurements give, incidentally, approximate values for the thermal conductivity of the oxides used. W. S. S.

4070. Infra-Red Radiations from Small Particles. A. H. Pfund. *J.O.S.A.* 23. *pp.* 270–273, *Aug.*, 1933.—It has been shown that crystals whose particle-size is small in comparison with the wave-length absorb but do not reflect within the region of selective absorption. It is suggested that within this region a powder ought to reveal an emission maximum. This suggestion is put to experimental test which shows that powder-films of quartz, barium sulphate and potassium carbonate show pronounced emission maxima. The behaviour of quartz-powder is shown to be quite the inverse of that of a polished quartz plate. [See Abstract 3984 (1930).] AUTHOR.

4071. Azimuthal Effect of Cosmic Radiation. M. S. Vallarta. *Phys. Rev.* 44. *pp.* 1–3, *July* 1, 1933.—In continuation of a former paper [see Abstract 1871 (1933)] the author discusses a possible azimuthal effect of cosmic radiation in the light of the discovery that this radiation appears to be predominantly positively charged. There appears to be some agreement between the predicted angle of the cone through which radiation should enter and the results obtained from Compton's directional experiments. It is concluded that the greater part of cosmic radiation consists of protons or positive electrons. J. E. R. C.

4072. Measurements of Cosmic Radiation by a New Kind of Counting Tube. L. Tuwim. *Comptes Rendus,* 197. *pp.* 79–81, *July* 3, 1933.—Further particulars are given of results obtained with the new counting tube referred to in a previous paper [see Abstract 2386 (1933)]. Experiment indicates that the action of the cosmic rays on matter consists of two distinct effects: ionisation, in which extra-nuclear electrons are concerned, and absorption, in which the nucleus plays a part. Experimental values obtained show that out of 10^8 collisions of a cosmic particle with molecules of air only one is nuclear. If each nuclear collision must give rise to a Hoffmann's impulsion the number of these impulsions would be found to be some hundreds of times too great. The difficulty may be avoided by supposing that (1) the nuclear collisions for the components of the cosmic radiation which are feebly penetrating produce groups of rays few in number and of low energy; (2) the Hoffmann's impulsions would be from groups produced only by the most penetrating component. The possibility of comparing directly the action of the cosmic rays on different chemical elements is the most important property of the new counting tube. J. J. S.

4073. Consequences of Observations on Cosmic Radiation. H. Rudolph. *Gerlands Beitr. z. Geophys.* 39. 2–3. *pp.* 260–262, 1933.—The author discusses some of the results of observations on cosmic radiation, and points out that these observations, as well as an explanation previously given by him of the mean daily variation of the earth's magnetism, are in opposition to the hitherto assumed hypothesis of a very small velocity of the kathode rays arriving at the earth from the sun. J. J. S.

See also Abstracts 3870, 4024, 4051, 4158, 4222.

RADIATION, GENERAL THEORY.

4074. Rapid Variations of Scalar Potential in Space. R. P. J. P. del Pulgar. *Ann. Soc. Sci. de Bruxelles,* 53. *pp.* 106–115, *June* 24, 1933.—Steinmetz showed that a sphere with varying potential loses a certain amount of energy which he calls electrostatic, but which is different from the electromagnetic energy lost by the conductor causing the loss of charge. A series of facts illustrate this view and some are given in the paper. The author considers that whatever view is formed of the field, whether action at a distance or by contact, by corpuscular heaps or a continuous medium, the field is always something whose variations, rapid or slow, obey Maxwell's laws. These Maxwellian equations also resemble those governing the elastic deformations of an incompressible medium. While admitting that luminous and all associated radiations are essentially of a transverse nature, it is suggested that in the electric field there are variations governed by laws similar to those of irrotational deformations and expressible by equations different from those of Gauss, although invariable with reference to the Lorentz transformations. Experience shows it is not the case for the stationary or quasi-stationary régime, but many facts, and also theory, suggest that it is true for rapid variations. This involves certain modifications of the classical equations such that they would be considered as limiting expressions on which one would fall back in the special case of the stationary or quasi-stationary regime.

R. S. R.

RADIATION, MECHANICAL EFFECTS.

4075. Possible Common Cause for Sub-Electronic Charge and Electrophotophoresis. K. Sitte. *Phys. Zeits.* 34. *pp.* 473–478, *June* 15, 1933.—Sets forth a hypothesis, not at present capable of direct proof, which would account for both sub-electronic charge and electrophotophoresis, and would besides enable the substances to be predicted which would manifest the latter phenomenon. A. D.

REFLECTION. REFRACTION AND DISPERSION.

4076. Property of the Refraction of Pencils of Light Rays. A. Dargenton. *Rev. d'Optique*, 12. *pp.* 172–178, *April*, 1933.—The following theorem in geometrical optics is established: if a narrow pencil of solid angle ω emerging from a point A is refracted at a series of surfaces separating media of different refractive index and passes finally through some point A′ at which the right section of the pencil has area σ', then a narrow pencil of solid angle ω' emerging from the point A′ and being refracted by the same series of surfaces, will pass through A and will there have a right section of area σ where $n^2\omega\sigma = n'^2\omega'\sigma'$, the refractive indices of the media containing A and A′ being n and n' respectively. The theorem has applications in the calculation of brightness. W. S. S.

4077. Measurement of Focal Lengths. A. Biot. *Ann. Soc. Sci. de Bruxelles*, 53. *pp.* 99–106, *June* 24, 1933.—The author discusses first, points relative to the accuracy of measurements of focal distance such as are studied with the help of microscopic points with paraxial focal distances. Where the dimensions and indices of refraction of a lens system are known these distances can be calculated accurately, but with experimental measurements a lower precision only is attainable. The cases of images are considered with and without aberration. In the former case systematic errors occur and for the greatest accuracy measurements must be made where the aberration is a minimum. A formula is then established to obtain the focal distance by measurement of the size of the image of a distant scale and its use discussed when applied directly or with a collimator. For a precision of 0·5 % rough methods suffice while for a greater precision, a simple, precise, convenient and rapid method is suggested.

R. S. R.

4078. Optical Imagery. J. Picht. *Die Physik*, 1. 2. *pp*. 73–80, 1933.—This paper is a review of the more important work published during the three years up to the end of 1933 on the subject of optical imagery. It is divided under the following headings: general theoretical problems in geometrical-optical image formation, problems in the calculation of optical systems, experimental determination of the defects of optical systems, influence of diffraction on image formation, and the geometrical optics of inhomogeneous media. C. B. A.

4079. Method of Projecting Star Images having Coma and Astigmatism. R. Kingslake and A. B. Simmons. *J.O.S.A.* 23. *pp*. 282–288, *Aug*., 1933.—After a brief theoretical introduction, the procedure for plotting the sections of an imaging cone from a point source, for one single zone of a lens in the presence of one or more aberrations is explained. The process is much simplified by a convenient graphical construction. A method is then described for projecting the sections due to coma and astigmatism on a screen so that they may be shown to a class. Photographs are included in the paper which show how remarkably the projected sections agree with the theoretically computed figures. AUTHORS.

4080. New Optical Experiment and Use of Single Lens for High Magnification; Observation of Entoptic and Diffraction Phenomena. J. G. Winans. *J.O.S.A.* 23. *pp*. 289–292, *Aug*., 1933.—An interesting optical experiment may be performed with a camera and converging lens. An extension of the experiment by use of the eye in place of the camera makes possible high magnifications with a single lens, location of flaws in glass, observation and location of particles within one's own eye and observation of Fresnel diffraction effects. AUTHOR.

4081. Astigmatism and Curvature of Field in Wide-Aperture Optical Systems. E. Lihotzky. *Zeits. f. techn. Physik*, 14. 7. *p*. 294, 1933.—A simplified method of evaluating the astigmatism and curvature of field near the axis in a wide-aperture system when corrected for spherical aberration and coma, is briefly indicated. W. D. W.

4082. Ray-Surface and Optical Indicatrix. G. Tunell. *Washington Acad. Sci., J.* 23. *pp*. 325–338, *July* 15, 1933.—An elementary account, without mathematical equations, of the nature and use of the ray-surface and optical indicatrix in the solution of standard problems connected with double-refraction in uniaxial and biaxial crystals. J. T.

4083. Studies in Refractive Index. Part III. A. M. Taylor and Dorothy A. Durfee. *J.O.S.A.* 23. *pp*. 263–269, *Aug*., 1933.—In this paper experiments are described which indicate by direct interferometric measurements the distance of penetration of light into the second medium at total reflection. The intensity of the superficial wave is greater in the case when the electric vector of the incident light is in the plane of incidence than when it is perpendicular to this plane, as is required by theory. A method of multiple reflection was devised whereby the reflection coefficients in the two cases could be photometrically compared when the second medium is absorbing. The absorption coefficient and the refractive index of the liquid were measured in layers of the order of 10^{-3} cm. thick and the values compared with the values deduced from the theoretical equations for the reflection coefficients. The results indicate that, for a saturated aqueous solution of potassium permanganate, the solvent is preferentially adsorbed at the surface, giving rise to smaller absorption of the superficial wave than would be expected from measurements of the absorption coefficient in the bulk. [For Parts I and II see Abstract 3528 (1933).] AUTHORS.

4084. Phase Equilibrium Relationships Determining Glass Compositions. G. W. Morey. *Indust. and Engin. Chem.* 25. *pp.* 742–748, *July*, 1933.—Glasses are undercooled liquids, the term "liquid" having the technical meaning used in phase equilibrium work. Glasses have passed from the thin molten condition obtaining during their manufacture through a continuously changing sequence of properties, to a hard, brittle substance of sufficient strength and rigidity to be of value in technology. The glasses used in the olden days do not differ greatly in composition from most of the glassware to-day, as the particular properties required of a practical glass composition necessitate that it differs little from the ternary eutectic between the compounds $Na_2O.2\ SiO_2$, $Na_2O.3\ CaO.6\ Si\ O_2$, and quartz, in the ternary system $Na_2\ O\text{-}Ca\ O\text{-}Si\ O_2$, because only when of such a composition is it both fluid enough at easily attainable temperatures to be readily melted on a commercial scale, and at the same time viscous enough at its freezing point so that devitrification is inhibited. The relation of various complex glasses to this simple eutectic glass is discussed. While the knowledge of glass composition is extensive, practically nothing is known about its constitution. W. D. W.

4085. Critical Temperatures in Silicate Glasses. J. T. Littleton. *Indust. and Engin. Chem.* 25. *pp.* 748–755, *July*, 1933.—There are no critical temperatures in the properties of glasses. There is a change of some sort, possibly in the degree of dissociation or a molecular aggregation which occurs at all temperatures until a stabilisation has taken place. This change is resisted by the viscosity of the glass. At low temperatures the retardation is so great that the change is never measurable in finite times; at intermediate temperatures it is observable, and at high temperatures it is sufficiently rapid so as to completely follow the temperature. The changes in the expansion coefficient, specific gravity, electrical conductivity, and heat absorption or specific heat are changes in the properties of the material attending these changes in state. At or around the annealing temperature the glass is sufficiently fluid for these changes to be observable during the course of the measurements if the rates of temperature change are rapid. If, however, the rate of temperature change has been slow enough so that at all times the glass was in a state of equilibrium, there would have been no apparent discontinuities in the data, but only a gradual change as the equilibrium condition of the glass changed. The question as to what this change in condition, dissociation, or molecular aggregation may be, is still unanswered. W. D. W.

4086. Chemical Composition of Commercial Glasses. D. E. Sharp. *Indust. and Engin. Chem.* 25. *pp.* 755–764, *July*, 1933.—The ranges of composition of a wide variety of modern commercial glasses are given, and some of the reasons why the compositions have been gradually altered from those in use some years ago are indicated. Analyses of many of the glasses are included, and coloured glass, technical glass and optical glass compositions are treated briefly. W. D. W.

See also Abstracts 3888, 3899, 3964, 4156.

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SPECTROSCOPY.

4087. Infra-Red Arc Spectra of Manganese and Rhenium. W. F. Meggers. *Bureau of Standards, J. of Research,* 10. *pp.* 757–769, *June,* 1933.—New types of photographic plates sensitive to infra-red radiation are employed to explore the long-wave portions of manganese and rhenium arc spectra from 7200 to 11,000 Å. The sources were metallic manganese in a copper arc and metallic rhenium in a silver arc. The spectrograms were made with large concave grating spectrographs, the first half of the range being investigated with a threefold increase in dispersion and resolution. Many new lines have been recorded in each spectrum, and these in turn have disclosed new spectra, terms or atomic energy levels. Lines in both spectra exhibit hyperfine structure. AUTHOR.

4088. Spark Spectrum of Copper between 400 and 240Å. L. and E. Bloch. *Comptes Rendus,* 197. *pp.* 132–134, *July* 10, 1933.—Owing to improvements in apparatus the authors have been able to prolong the spectrum of Cu given in a previous paper [see Abstract 593 (1933)] as far as about 240 Å. A list of the lines from 383·33 Å to 240·40 Å is given with the wave-lengths obtained by Millikan recorded for comparison. J. J. S.

4089. Multiplets in the Spectra of O III, O IV, O V and C III. P. G. Kruger and W. E. Shoupp. *Phys. Rev.* 44. *pp.* 105–108, *July* 15, 1933.—The spectra of oxygen and carbon have been photographed in the region 100 to 650 Å with a 21-foot grazing incidence vacuum spectrograph. A hot spark was used as the light source. Transitions between $2s^22p3d\ {}^3D^0$, ${}^3P^0$, $2s^22p3s\ {}^3P^0$ and $2s^22p^2\ {}^3P$ of O III terms were observed. The separation of the levels arising from the lowest electron configuration is thus fixed. Nebular lines fit these term differences very well. In O IV the quartet intercombinations $2s2p^2\ {}^4P$ to $2s^23s\ {}^4P^0$, $2s2p3d\ {}^4D^0$, ${}^4P^0$ have been found. This connects the two quartet systems and a revised term table is given. The $\Delta\nu$ separations of three O V triplets have been measured but do not agree too well with other data. Two C III triplets, previously observed by Bowen as doublets, have been resolved and fit the calculated $\Delta\lambda$'s. AUTHORS.

4090. Spectrum of the A⁺⁺ Ion, A III. V. v. Keussler. *Zeits. f. Physik,* 84. 1–2. *pp.* 42–55, *July* 17, 1933.—The spectrum of doubly ionised argon was studied using the electrodeless ring discharge and the condensed discharge, observations being made with a vacuum spectrograph. The wave-numbers, approximate intensities and term derivations of some forty lines are given. Line groups of the term system with the term limit ${}^4S$ were identified and the corresponding term values calculated. For the ionisation potential of the A^{++} ion the value 40·7 volts was obtained. Another strong group of lines was correlated with combination of the ground term with the deepest term of the system with the limit ${}^2D$. Comparison with the SI and Cl II spectra showed that the principal quantum numbers assigned by Frerichs to the D terms of the ${}^4S$ system of sulphur must be reduced by unity. W. S. S.

4091. Pressure Effects of Foreign Gases on the Sodium D-Lines. H. Margenau and W. W. Watson. *Phys. Rev.* 44. *pp.* 92–98, *July* 15, 1933.—The effects of foreign gases (A, N_2 and H_2) on the D-lines of Na have been studied by means of a steel absorption chamber, in which the Na-vapour pressure is kept low while the foreign gas pressure varies between

0 and 17 atmospheres. Temperatures were such that true line contours could be photographed and photometrically evaluated. Results are: (1) The red shift of the absorption maximum varies linearly with the density of the perturbing gas. (2) Study of the line contours reveals marked asymmetries, most pronounced near the base. Asymmetries are to the red in case of A and N_2, slightly to the blue for H_2. (3) Both D-lines show the same broadening and shift. (4) The effects can be accounted for theoretically by assuming a distance of closest approach between excited Na and the foreign gas molecules of about 9 Å. Quantitative results are summarised. AUTHORS.

4092. Temperature Classification of the Spectrum of Neodymium. A. S. King. *Astrophys. J.* 78. *pp.* 9–45, *July*, 1933.—The paper gives the temperature classification of 2863 Nd lines in the spectral range λλ 2963–7005, based on their relative intensities at three temperature stages of the electric furnace. The neutral spectrum, strong in the furnace, includes many lines that are faint in the arc, especially in the shorter wave-length region, a large proportion of which are now measured for the first time. The spectrum is notable for the large number of lines in classes I and II, which are well developed at 2000° C., while the neutral lines in higher classes appear near 2300°. The classification includes also the stronger lines of singly ionised Nd, selected by comparing the furnace spectra with those of the arc and spark. A majority of these enhanced lines are present in the furnace spectrum at 2600°. Wave-lengths of 2026 lines were measured, comprising new neutral lines and others for which improved wave-lengths could be obtained. The dominance of the lines of Nd I, Nd II, and Nd III in different spectral ranges is discussed. A comparison of Nd spectrograms with those of Sm was made with reference to lines apparently common to both spectra, which might belong to the intermediate element 61. Lines of this character given by the samples used in this investigation appear, however, to result from chance coincidences of true Nd and Sm lines. AUTHOR.

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4093. Hyperfine Structure and Nuclear Moments of Rubidium. H. Kopfermann. *Zeits. f. Physik*, 83. 7–8. *pp.* 417–430, *June* 28, 1933.—The hyperfine structures of a number of rubidium spark lines are analysed. The mechanical nuclear moment of the isotope Rb87 is found to be I = 3/2 and for the isotope Rb85 a most probable value, I = 5/2, is obtained. The magnetic moment of the Rb87 nucleus is exactly twice as big as the magnetic moment of the Rb85 nucleus. No isotope displacement effect is observed. J. E. K.

4094. Deepest Excited Terms of Neon by Slater's Method. S. Rozental. *Zeits. f. Physik*, 83. 7–8. *pp.* 534–542, *June* 28, 1933.—Using Slater's method, the author gives a theoretical derivation of the numerical values of the deepest excited neon terms, and obtains satisfactory agreement with the experimental values given by Paschen. W. S. S.

4095. Quantitative Determination of the Excitation Functions of some Terms of the Mercury Atom. R. Seiler. *Zeits. f. Physik*, 83. 11–12. *pp.* 789–805, *July* 8, 1933.—The loss of energy suffered by a uniform beam of electrons of known initial velocity (between 3 and 50 volts), in passing through mercury vapour of known density, is determined. From the calculated number of inelastic electron collisions, and the total number of collisions made by the electrons according to the diffusion theory of

G. Hertz, the probability of excitation of a quantum-jump is determined. For the individual quantum transitions this probability is represented as a function of the energy of the electrons. The excitation function of the transition $1^1S_0 - 2^3P_1$ has a maximum about 6·9 volts; at this maximum the probability of excitation is about 4 or 5 % of the gas-kinetic collisions. The excitation function of the transition $1^1S_0 - 2^1P$ consists of two branches having maxima at 7 and 19 volts respectively; the corresponding excitation probabilities are 1 % and 3 %. J. E. K.

4096. Line Spectra of Atoms. Part I. G. Joos. *Die Physik*, 1. 2. *pp*. 81–100, 1933.—A general article dealing with the laws of line spectra. The theory of multiplets, hyperfine structure and questions of intensity are considered. The influence of external fields on spectrum lines is also dealt with. F. S.

4097. Band Spectra Superimposed on the Continuous Spectra of Mercury in the Visible Region. J. Okubo and E. Matuyama. *Tohoku Univ., Sci. Reports*, 22. *pp*. 383–392, *May*, 1933. *In English*.—On exciting mercury vapour in a tube of a reflux condensation type by h.f. oscillatory currents of $3 \times 10^7 \sim$ with external electrodes, the appearance of two systems of bands was observed, one superimposed on the continuous spectra in the region between 4340 Å and 4078 Å, and the other in the region between 4047 Å and 3650 Å. The former system appears with doublet-like heads whose separations are about 12 cm^{-1}.; the latter had already been reported as a diffuse band, but on examining with a spectrograph of higher dispersion, finer structure which consists of many heads at nearly equal intervals 17 cm^{-1}. was revealed. The wave-lengths of the heads were measured, and some views are given as to the appearance of the band. AUTHORS.

4098. λ2875 Band of Neutral OH. T. Tanaka and M. Siraisi. *Phys. Math. Soc., Japan, Proc*. 15. *pp*. 195–209, *May*, 1933. *In English*.—The OH bands as given by a hydrogen flame fed with oxygen are photographed with a Hilger E1 spectrograph. The λ2875 band is studied in detail, and some changes are made in the original assignments given by Watson [see Abstract 572 (1925)]. The molecular constants obtained from this study are $B' = 15·283$ cm^{-1}. and $B'' = 17·831$ cm^{-1}. The origin of certain satellite lines is discussed, both for the λ2875 and the λ2811 band. A. H.

4099. New Bands in the Spectrum of Vanadium Monoxide. G. Piccardi. *Accad. Lincei, Atti*, 17. *pp*. 836–838, *May* 21, 1933.—The author, considering that in the electric arc the diatomic molecules VO are largely dissociated into atoms of V and O, has examined the spectrum of VO in a flame of lower temperature and has obtained for the first time a spectrum of complete bands. The bands observable are twelve and were not resolvable into lines with the apparatus used. The system can be represented by means of the following formula:

$$\nu = 17424·6 + 857·2\,n' - 4·6\,n'^2 - 1005·1\,n'' + 5·7\,n''^2.$$

Too high a temperature, in the case of the spectrum of various monoxides, leads to the disappearance of groups of bands situated towards the small wave-lengths. J. J. S.

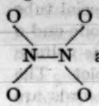
4100. Absorption Bands of Coloured Alkali Halides. J. H. de Boer and W. de Groot. *Zeits. f. Physik*, 83. 7–8. *pp*. 517–520, *June* 28, 1933.—It is pointed out that the relation $\nu d^2 = 0·45$ cm^2. sec^{-1}., deduced theoretically by Fröhlich, corresponds to the excited condition of a crystal grating and is not to be identified with Mollwo's empirical relation ($\nu d^2 = 0 \cdot 50$ cm^2. sec^{-1}.), which concerns absorption of loosely-bound alkali atoms. F. S.

4101. Structure and Zeeman Effect of the Doublet CO_2 Emission Bands at 2900Å. R. Schmid. *Zeits. f. Physik,* 83. 11–12. *pp.* 711–738, *July* 8, 1933.—The emission band complex at 2900Å of the CO_2 (or CO_2^+) molecule is photographed in the first and second orders of a 21-ft. concave grating. Exposures of 50 hours are made, both with and without a magnetic field (15,000 and 28,200 gauss). It seems probable that the complex represents a $^2\Pi(a) \longleftrightarrow {}^2\Pi(b)$ transition. The strong zero-zero band appears to be covered over by others, which probably correspond to a higher excitation of the quantum-number X (rotation of the carbon atom about the axis joining the three nuclei). The lines can be arranged in P- and R-branches, the null-branches close in on one another to form strong lines on account of the equality of the rotation constants of the upper and lower levels. Disturbances of various kinds (sharpness of line, separation and intensity) are observed in the sequence of branch lines ; a magnetic field appears to reduce many of these disturbances. The Λ-like doublet manifests itself in the present case within a certain region by displacements and by producing the effect of a 20% greater rotation constant. J. E. K.

4102. Infra-Red Spectrum of Carbon Dioxide. Part II. A. Adel and D. M. Dennison. *Phys. Rev.* 44. *pp.* 99–104, *July* 15, 1933.—The interaction between the vibration and rotation of the CO_2 molecule is discussed. It is shown that the fine-structure lines will exhibit a convergence which depends upon certain of the anharmonic potential constants. The convergence factors are compared with the experimental data of the resolved bands and an excellent agreement is found, which leads to a determination of the anharmonic constants. Combining these results with those of Part I [see Abstract 3027 (1933)] the complete potential function for CO_2 is obtained. A simple analytic function for the potential is proposed which contains but four constants. It is shown that this function agrees satisfactorily with the experimental potential for small displacements. The range of the validity of the analytic function is discussed, and one of the heats of dissociation of CO_2 is obtained. AUTHORS.

4103. Resolution of the Two Difference Bands of CO_2 Near 10μ. E. F. Barker and A. Adel. *Phys. Rev.* 44. *pp.* 185–187, *Aug.* 1, 1933.—The rotational structure of two absorption bands of CO_2 at $9 \cdot 4\mu$ and $10 \cdot 4\mu$ has been completely resolved. Both bands have positive and negative branches, but no zero branches. They correspond to transitions up to the state ν_3 from the double state (ν_1, $2\nu_2$), and yield the value $102 \cdot 8$ cm^{-1} for the separation of the two levels. From the intensity distribution of the lines it is clear that J must have only even values in the normal molecule. The line separations and convergences provide a very precise value for the moment of inertia, namely $70 \cdot 6 \times 10^{-40}$ gm. cm^2. The numerical agreement with predictions from formulæ based upon previous measurements with other bands is very satisfactory. [See preceding Abstract.] AUTHORS.

4104. Infra-Red Absorption Spectrum of Nitrogen Tetroxide. G. B. B. M. Sutherland. *Roy. Soc., Proc.* 141. *pp.* 342–362, *Aug.* 1, 1933.—An account is given of new experimental work on the infra-red spectrum of nitrogen peroxide. It has been possible to distinguish the absorption bands due to the N_2O_4 molecule from those due to the NO_2 molecule, and the main bands due to the former have been examined under high resolution. The normal vibrations of a molecule of the form



are discussed and the main features of its infra-red and Raman spectra are predicted. The new data on the infra-red and Raman spectra of nitrogen tetroxide are critically compared with these predictions and found to receive a very satisfactory interpretation. Certain relations between the 12 fundamental frequencies are deduced by making two very simple assumptions regarding the nature of the force fields in the molecule. These relations are used to confirm the assignments based on more qualitative arguments and enable 11 of the 12 fundamental frequencies to be determined. A discussion of the specific heat of nitrogen tetroxide is given as a means of determining the 12th fundamental. On account of the uncertainty in the experimental data it is impossible to obtain even a rough estimate of this frequency. A theoretical figure is given for the specific heat, *viz.*, 14 cal. per mole, which is possibly correct to 10%. AUTHOR.

4105. Rotational Analysis of the Perturbed (13, 15) $^2\Sigma-{}^2\Sigma$ N_2^+ Band. A. E. Parker. *Phys. Rev.* 44. *pp.* 90–91, *July* 15, 1933.—A rotational analysis of the 13,15 $^2\Sigma-{}^2\Sigma$ N_2^+ band has been made. This analysis is of interest as a perturbation is found to occur in the upper state. The rotational analysis gives the following constants: $B_{13}'=1\cdot54_5$ cm^{-1}, $D_{13}'=-5\times10^{-5}$ cm^{-1}, $B_{15}''=1\cdot62$ cm^{-1} and $D_{15}''=-1\times10^{-5}$ cm^{-1}. The origin of the band is at 21044·7 cm^{-1}. AUTHOR.

4106. Recombination Radiation in the Cæsium Positive Column. F. L. Mohler. *Bureau of Standards, J. of Research,* 10. *pp.* 771–780, *June,* 1933.—The radiation emitted along the axis of a positive column has been measured by spectrophotometric methods and electrical measurements have been made with small probe surfaces near the line of sight. The continuous spectrum near the 6^2P limit was measured with pressures ranging from 0·8μ to 290μ and with a 50-fold range of electron concentration, N_e. At low pressures the intensity varies as N^2_e and is nearly a linear function of pressure with about twice the zero pressure value at 9μ for $N_e=10^{12}$ or less. At higher pressures and high values of N_e the increase in intensity is less than N^2_e. The intensity near the 5^2D limit remains nearly equal to that at 6^2P for pressures above 3μ. At high pressures the subordinate and fundamental series lines change in the same way as the continuous spectrum. The low-pressure measurements give a basis for evaluating the probability of spontaneous recombination of an ion and an electron into the 6^2P level. The effective collision area for 0·3 volt electron is $1\cdot7\times10^{-21}$ cm^2. The effect of vapour density is to increase the probability of transition. Expressed as a 3-body collision, recombination takes place if an electron and an atom are simultaneously within 6×10^{-8} cm. of an ion. With high electron concentration radiation is suppressed in a process which is probably the converse of ionisation by collision. This quenching process takes place when two electrons are simultaneously within a distance of about 10^{-7} cm. of an ion, but the distance increases with vapour density. AUTHOR.

4107. Comparison of the Distribution of Energy in the Continuous Spectra of the Blue and Violet Glows of Molecular Hydrogen. D. Chalonge and E. Vassy. *Comptes Rendus,* 196. *pp.* 1979–1981, *June* 26, 1933.—The emission is excited in a special tube containing hydrogen and provided with a hot oxide-coated kathode and a nickel anode. Under suitable conditions a small increase of anode voltage causes the appearance of the glow to change from blue to violet. The continuous spectra are photographed and microphotometric records are given. The energy distribution is different in the two cases, the results being in harmony with earlier observations and the explanation proposed for them [see Abstract 3441 (1931)]. L. A. W.

4108. Variation with Temperature of the Continuous Absorption Spectrum of Diatomic Molecules. Part I. Chlorine. (Experimental.) G. E. Gibson and N. S. Bayliss. *Phys. Rev.* 44. *pp.* 188–192, *Aug.* 1, 1933.—A photographic method was used to investigate the continuous absorption spectrum of chlorine at 18°, 168°, 281°, 426°, 580° and 765° C. The effect of increasing the temperature is to decrease the absorption coefficient at the maximum, and to broaden the region of continuous absorption. The results were analysed to obtain the contributions of individual vibrational levels to the total absorption. The absorption from the level $v''=0$ has a single maximum, that from the level $v''=1$ has two maxima, and it appears probable that the absorption from the level $v''=2$ has three maxima. [See following Abstract.] AUTHORS.

4109. Variation with Temperature of the Continuous Absorption Spectrum of Diatomic Molecules. Part II. Theoretical. G. E. Gibson, O. K. Rice and N. S. Bayliss. *Phys. Rev.* 44. *pp.* 193–200, *Aug.* 1, 1933.—A method of calculating the matrix components, corresponding to the continuous absorption of light by diatomic molecules in various vibrational and rotational levels of the lower state, is described and applied to the calculation of the absorption of Cl_2 gas at various temperatures. The theory shows that the absorption from a single vibrational level is practically independent of temperature, and that the temperature effect is due to the changing distribution of the absorbing molecules among the various levels. Assuming the Morse function to be approximately correct for the potential energy of the lower state, the theory enables one to calculate the form of the upper potential energy curve. The matrix component of the electric moment corresponding to the absorption from the lower state has been calculated for Cl_2 and found to correspond to the displacement of one electronic charge through 0·016Å. [See preceding Abstract.] AUTHORS.

4110. Theory of Continuous Absorption of Oxygen at 1450Å. E. C. G. Stueckelberg. *Phys. Rev.* 44. *p.* 234, *Aug.* 1, 1933.—A correction. [See Abstract 633 (1933).]

4111. Photographic Photometry Methods of Measuring the Absorption of Solutions in the Visible Spectrum. F. W. Beyer. *Zeits. f. Physik,* 83. 11–12. *pp.* 806–813, *July* 8, 1933.—The absorption spectra, in the visible part of the spectrum, of two complex cobalt salts are measured and are compared with the measurements of previous investigators. A photographic method of measurement is used ; a rotating sector is applied for reducing the intensity of a continuous spectrum in known ratios, and equality of blackening of the absorption and comparison spectra is established by microphotometer measurements. J. E. K.

4112. Transmission of Resonance Radiation through a Gas. R. W. Ditchburn. *Roy. Irish Acad., Proc.* 41. *pp.* 47–60, *May,* 1933.—A mathematical paper which follows the general lines of Milne's work. In Section I the problem is shown to be formally a problem of transmission by absorption and scattering, and the relation of the absorption and scattering coefficients to the atomic constants is derived. In Section II two general propositions are derived, one of which is independent of some of Milne's assumptions. In Section III two special cases are considered. F. S.

4113. Excitation of Resonance Series in Sodium Vapour by Irradiation with the D-Lines. W. G. Brown and P. Pringsheim. *Zeits. f. Physik,* 82. 9–10. *pp.* 584–588, *May* 23, 1933.—Irradiation of sodium vapour at 320° C. by means of a Na-lamp gives a resonance spectrum with several negative members associated with the D-lines. The exposure times required in photographing this spectrum are over 24 hours. The identity of the spectrum with that obtained by electrical excitation provides confirmation of the explanation of its occurrence given by Schüler and by Kimura and Uchida [see Abstracts 3123 (1927) and 3752 (1932)]. In connection with the effect of the addition of foreign gases an apparent contradiction of observations by Wood is accounted for as due to the nature of the experimental arrangements. L. A. W.

4114. Two New Resonance Series in Antimony Vapour. R. Siksna. *Comptes Rendus,* 196. *pp.* 1986–1987, *June* 26, 1933.—Two new resonance series of Sb_2 are discovered by illuminating antimony vapour at 950° C. with a condensed Mg spark. The exciting lines are 2929 and 2937 Å, and each series comprises one negative and fifteen positive lines. The frequency formulæ indicate that the series probably correspond to the same system of energy levels as the series recently obtained by Genard. L. A. W.

4115. Mean Life of the 2^3P_1 State of Cadmium by Photometry of the Resonance Radiation of a Beam of Cadmium Atoms. P. Soleillet. *Comptes Rendus,* 196. *pp.* 1991–1993, *June* 26, 1933.—A narrow region of a beam of cadmium atoms is illuminated by a beam of unpolarised light from a cadmium arc, and a magnetic field of a fraction of a gauss is applied along the direction of excitation. Under these conditions the polarisation of the light emitted by resonance in a given direction is independent of the time between excitation and emission. The beam of atoms is photographed through an arrangement of two Wollastons such that subsequent microphotometry of the plate gives a measure of the distance along the atomic beam corresponding to a decrease of intensity in a definite ratio. The theoretical expression for this distance involves the mean life of the atomic state 2^3P_1 concerned, which can hence be calculated. The value $2 \cdot 45 \times 10^{-6}$ sec. obtained is compared with the values determined by other methods. L. A. W.

4116. Fluorescence with Atomic Lines of Antimony Vapour. R. Siksna. *Comptes Rendus,* 197. *pp.* 134–136, *July* 10, 1933.—The vapour of Sb was placed in a silica vessel with an addition at the side by which the pressure of the vapour could be varied independently of the temperature. By means of two electric furnaces, it was possible to cause the temperature and pressure to change. On illuminating the vapour of Sb by the light from a Cd spark strongly condensed there was observed in the spectrum of the fluorescence two atomic lines of Sb, 2877·9 Å (intense) and 2311·5 Å (more feeble). The temperature of the vapour was 950° C., the pressure corresponding to the same temperature. On lowering the temperature in the pressure furnace to 520° C. the emission remained visible, but the lines became more feeble. At a pressure corresponding to 360° C. they became invisible. The emission of the lines may be explained by a purely atomic excitation. On illuminating Sb vapour by a Zn spark fluorescence with atomic lines of Sb was observed, but with a different character. Other lines which were observed are given, and the emission of the lines is regarded as due to an absorption of molecular origin followed by a dissociation. J. J. S.

4117. Zeeman Effect for Perturbed N_2^+ Terms. A. E. Parker. *Phys. Rev.* 44. *pp.* 84–89, *July* 15, 1933.—The Zeeman effects for the perturbed terms in the $v=1$ and 3 levels of the upper $^2\Sigma$ state of N_2^+ have been investigated at various field-strengths up to 27,000 gauss. At the points of maximum perturbation the Zeeman patterns are doublets for the moderate and high field-strengths. At high field-strengths the unperturbed lines, of the same K value as the most perturbed lines, also become doublets under the influence of the magnetic field. This is attributed to a Paschen-Back effect. For K values greater than those of the maximum perturbation point, all the lines exhibit an asymmetric broadening in the field. A consideration of the interactions with the perturbing $^2\Pi$ state gives an explanation of the patterns observed. AUTHOR.

4118. Comparative Intensity Measurements on the Raman Lines of Inorganic Ions. I. Hansen-Damaschun. *Zeits. f. phys. Chem.* 22. *Abt.B.* 1–2. *pp.* 97–113, *June*, 1933.—A photographic photometric method is employed in comparative determinations of the intensities of a number of Raman lines of different inorganic ions relative to the intensity of the corresponding primary line. For this purpose intensity marks are recorded on each plate together with the Raman spectrum and the primary spectrum, exposed for the same time. In the case of the primary spectrum the light from the source is reflected from a lampblacked surface introduced in place of the Raman tube. The results, interpreted in the light of Placzek's theory of the Raman effect, provide evidence that in ions like SO_4'' and NO_3' the bond is less polar in character than that between the NH_3 and the metal atom in complex ions like $Zn(NH_3)_6^{\cdot\cdot}$ and $Cd(NH_3)_6^{\cdot\cdot}$. L. A. W.

4119. Two New Raman Bands of Water. M. Magat. *Comptes Rendus*, 196. *pp.* 1981–1983, *June* 26, 1933.—A suitable filter being used to suppress the continuous background of the mercury lamp, pure water is found to give a Raman band with $\Delta\nu=396$–796 cm.$^{-1}$, excited by 4358 Å. The corresponding band excited by 2537 Å gives the value $\Delta\nu=465$–766 cm.$^{-1}$. In addition, a second band is found with $\Delta\nu=150$–225 cm^{-1}. Both these bands are also observed for solutions of certain salts. It is suggested that the former frequency corresponds to an internal vibration of the H_2O molecule, and the latter to a vibration of an associated complex. L. A. W.

4120. Raman Spectra of Oximes. G. B. Bonino and R. Manzoni-Ansidei. *Zeits. f. phys. Chem.* 22. *Abt.B.* 3. *pp.* 169–180, *July*, 1933.—Raman spectra are reported for methyl-ethyl-ketoxime, methyl-n-propyl-ketoxime, methyl-n-butyl-ketoxime, methyl-ethyl-ketoxime-o-methylether, camphoroxime-o-methylether, α-benzaldoxime, acetophenone-oxime (and sodium salt), sodium salt of o-chlorobenzaldoxime. As a result the line 1630 cm.$^{-1}$ is attributed to the C=N bond, and agrees with the usual formula attributed to oximes, while for the sodium salts of the aromatic oximes the nitron-formula with semi-polar bond is indicated. A. C. M.

4121. Raman Effect in Complex Cyanides. R. Samuel and M. J. Khan. *Zeits. f. Physik,* 84. 1–2. *pp.* 87–91, *July* 17, 1933.—In continuation of previous work [see Abstract 1504 (1933)] the Raman effects exhibited by aqueous solutions of complex cyanides of chromium, cobalt, nickel, ruthenium and rhodium have been determined. The Raman spectra of cyanides of coordination number 6, are characterised by two Raman frequencies, the one associated with the oscillation of the C atom about the N atom, the other attributable to oscillation of the CN group about the central atom. This latter frequency is lacking in the case of complex cyanides of coordination number other than 6. The application of these results to the discussion of the homopolar nature of coordination combination and the difference of mechanism characterising combination when the coordination number is different, is briefly referred to. J. S. G. T.

4122. Raman Spectrum of Tetramethylmethane. D. H. Rank. *J. Chem. Phys.* 1. *pp.* 572–575, *Aug.,* 1933.—Raman spectra of tetramethylmethane, the mono chloro derivative of tetramethylmethane and *n*-amyl chloride, have been obtained with a spectrograph which gave a dispersion of 14 Å/mm. at λ4500. Filters were employed which permitted the observation of the weaker lines. The rather simple arrangement of very intense quartz water-cooled vacuum mercury arcs is described. The results for tetramethylmethane confirm the predictions of the theory of the vibration spectrum of the hydrocarbons which was developed by Kohlrausch and Barnes. AUTHOR.

4123. Mathematical Methods for Computing Thermodynamic Functions from Spectroscopic Data. L. S. Kassel. *J. Chem. Phys.* 1. *pp.* 576–585, *Aug.,* 1933.—Methods of summation are given for the Q-sum, and the related sums which are needed in calculating free energies, entropies and heat capacities from spectroscopic data. All necessary formulæ are presented for the treatment of a linear molecule with arbitrary orbital angular momentum, spin multiplicity and nuclear symmetry. The non-linear molecule is much more difficult; necessary formulæ are given for the special case of a $^1\Sigma$ molecule with two equal principal moments of inertia. The application of these methods is illustrated by the calculation of the entropy, heat content and heat capacity of carbon monoxide from 50 to 5000° K. AUTHOR.

4124. Empirical Molecular Heat Equations from Spectroscopic Data. W. M. D. Bryant. *Indust. & Engin. Chem.* 25. *pp.* 820–823, *July,* 1933.—The calculation of molecular heats of gaseous substances from spectroscopic vibration frequencies is briefly discussed. The methods outlined are applied to eighteen gases and vapours. The theoretical molecular heats are found to be in close agreement with the more reliable of the experimental results. A group of sixteen empirical second-power equations is derived to fit the theoretical molecular heat curves from 300° to 2000° K. The maximum deviation of the empirical from the theoretical seldom exceeds 3 %. It is believed that these equations as a group may be more reliable than previous empirical expressions based on experimental specific heats and covering a similar temperature range. AUTHOR.

4125. Quantitative Analysis by Spectroscopic Methods. O. S. Duffendack, R. A. Wolfe, and R. W. Smith. *Indust. & Engin. Chem.* (*Analytical Edition*) 5. *pp.* 226–229, *July* 15, 1933.—Spectroscopic methods for estimating the amounts of various elements present in a mixture, alloy, or solution are reviewed, and the continued advance in the precision of the determinations is noted. Further increase in precision has been attained by the authors, by making use of methods recently developed for measuring the intensities of spectral lines, and by a simple means of standardising the arc source used in the analysis of metallic alloys. The necessity for putting an intensity calibration pattern on each photographic plate in order to insure uniformity and high precision of measurement is emphasised. The procedure adopted by the authors in making analyses of metallic alloys is described. AUTHORS.

4126. Spectrum Analysis and Electrical Investigation of the Purest Platinum. W. Gerlach and Else Riedl. *Phys. Zeits.* 34. *pp.* 516–522, *July* 1, 1933.—The technique of spectrum analysis for the detection of small quantities of impurity is described, and an arc with rotating electrodes is illustrated. The results obtained with these samples of commercial platinum are compared with those for a sample of pure platinum found by Meissner to have a very small residual resistance between 4° and 1°·35 Abs. F. S.

See also Abstracts 3934, 3935, 3976, 4054, 4055, 4064, 4068, 4197, 4205.

VISION.

4127. Visibility of Objects Illuminated by a Projector. Part III. J. Rivière and Y. Rocard. *Rev. d'Optique,* 12. *pp.* 160–171, *April,* 1933.—The application to practical cases of the methods and formulæ already given [see Abstracts 4214 (1932) and 3052 (1933)] is here considered in detail. Comparisons are made between the calculated visibility of an object in a searchlight beam and the observed values, good agreement being obtained. Data are given showing the performance of a searchlight to be expected for different atmospheric absorptions. W. S. S.

4128. Accuracy of Refraction Measurements of the Eye. A. Kühl. *Zeits. f. techn. Physik,* 14. 7. *pp.* 294–295, 1933.—The accuracy of refraction measurements is discussed for various conditions of accommodation. An accuracy of ± 0·2 to 0·3 dioptres for a mean accommodation range is indicated. W. D. W.

See also Abstracts 4061, 4065, 4080.

X-RAYS.

4129. Emission of a Very Soft Radiation by Electrified Insulators. G. Reboul. *Comptes Rendus,* 196. *pp.* 1987–1989, *June* 26, 1933.—Simple electrification of insulating substances (sulphur, resin, paraffin wax, ebonite) by friction is found to give results similar to those previously observed with semi-conducting cells [see Abstract 3785 (1932)]. The disappearance of the charge is accompanied by the emission of very absorbable radiation capable of affecting a photographic plate and possessing a marked ionising power. L. A. W.

4130. Spectrographic Investigation of the Radiation from Semi-Conducting Cells. G. Déchêne. *Comptes Rendus,* 196. *pp.* 1989–1991, *June* 26, 1933.—The spectrum of the radiation emitted by semi-conducting cells to which a potential difference of several thousand volts is applied is photographed in a vacuum grating spectrograph. It is found necessary to use wide slits to define the incident beam, and hence the results are only rough. A narrow band is obtained at about 20 Å, together with a second wider band which overlaps the first and extends to about 200 Å. Plates with longer exposure times also show a third band between 250 and 700 Å. These results are in harmony with the conclusions of Reboul from absorption experiments. [See also Abstract 3785 (1932).] L. A. W.

4131. Demountable X-Ray Tube. E. P. Miller. *Rev. Sci. Instruments,* 4. *pp.* 379–380, *July,* 1933.—The paper describes a demountable X-ray tube suitable for use with each electrode at high potential, and gives the necessary modifications when it is required that one electrode shall be earthed. The tube comprises a metal discharge chamber, with insulating arms of porcelain or glass. The metal work is largely of brass, which is chromium plated to reduce sputtering. A feature of the tube is the elimination of wax joints, the high vacuum seals being made by means of gaskets of paranite rubber. Complete working drawings are given. G. E. B.

4132. Calcium Target for X-Ray Tubes. H. Kersten and J. Maas. *Rev. Sci. Instruments,* 4. *p.* 381, *July,* 1933.—In using common calcium compounds for targets in X-ray tubes, trouble is frequently experienced in obtaining the necessary vacuum. To overcome this the present target was developed. The target consists of a glass made from 5 gm. SiO_2 fused in a gas-oxygen flame with 5 gm. CaO and 0·3 gm. of clay. The button of glass is ground to the required shape on a carborundum wheel, and attached to the target holder by means of solder. A target of this type has been operated at a voltage of 10 kV, and a current of 10 A for three hours. G. E. B.

4133. Convergent X-Rays. K. Fritz. *Phys. Zeits.* 34. *pp.* 525–527, *July* 1, 1933.—The paper refers to the design of a metal X-ray tube by means of which monochromatic X-rays converging to a focus situated outside the tube may be obtained. The design is based on the Seemann-Bohlin focussing principle. W. E. P.

4134. Diffuse Scattering of X-Rays from Sylvine. Part IV. Scattering at High Temperatures. G. G. Harvey. *Phys. Rev.* 44. *pp.* 133–137, *Aug.* 1, 1933.—To ascertain the effect of temperature on the diffuse scattering of MoKα radiation from sylvine, intensity measurements have been carried out at 630° K. and 1020° K., which is about as close to the melting point (1049° K.) as it is feasible to work. It is again found that the results are in good agreement with the formula

$$S = (f^2 - F^2)/Z + (1 - f^2/Z^2)/(1 + \alpha \operatorname{vers} \phi)^3$$

provided experimental values of F are used rather than assuming $F = fe^{-M}$ where M is given by the Debye-Waller formula. [For Part III see Abstract 3057 (1933).] AUTHOR.

4135. Scattering of X-Rays from Powdered Crystals at Low Temperatures. G. E. M. Jauncey and F. Pennell. *Phys. Rev.* 44. *pp.* 138–140, *Aug.* 1, 1933.—Jauncey has suggested that the true atom form-factor of a crystal may decrease at low temperatures. With the method of Jauncey and Pennell [see Abstract 3055 (1933)], X-rays have been scattered from powdered crystals of KCl and NaF at various mean angles ϕ over a fairly wide range of $(\sin \frac{1}{2}\phi)/\lambda$ at each mean angle ϕ with the powdered crystal first at 295° K. and then at 103° K. Changes of the order of 1 or 2 % in the intensity of the scattered rays were observed. Various possible explanations for this change are discussed. It is concluded that from 295 to 103° K. the true atom form-factors of NaF do not change, while those of KCl either do not change or decrease by very small amounts which are less than, but of the same magnitude as, those indicated in a recent paper by Harvey [see Abstract 3057 (1933)]. AUTHORS.

4136. Structure of the X-Ray K-Absorption Limits of the Elements Mn to Zn. A. H. Barnes. *Phys. Rev.* 44. *pp.* 141–145, *Aug.* 1, 1933.—The double crystal spectrometer was employed to investigate the main absorption edge of the free elements Mn, Fe, Co, Ni, Cu and Zn, and the oxides Mn_2O_3, Fe_2O_3, Co_2O_3, Ni_2O_3, CuO, and ZnO. Definite structure was exhibited by all the free elements except Zn, and all the oxides except ZnO. The oxide edges were all displaced toward shorter wave-length. The observed width of the edges varied from 15 volts in the case of Zn to 23 volts for Fe. AUTHOR.

4137. Ionisation of Rare Gases by X-Rays. E. Wilhelmy. *Zeits. f. Physik*, 83. 5–6. *pp.* 341–350, *June* 20, 1933.—By means of measurements made relative to the ionisation in air the energy per pair of ions in neon was found to $27 \cdot 0 \pm 0 \cdot 6$ and in argon $24 \cdot 6 \pm 0 \cdot 7$ electron-volts (assuming the energy per ion-pair in air to be $32 \cdot 2 \pm 0 \cdot 5$ electron-volts). Both values were found to be independent of wave-length. In particular, in the work on argon no variations were found on passing the K-absorption limit. Account was taken of multiple-ionisation and of the kinetic energy of the electrons. G. E. B.

4138. Passage of Photons through Atoms. V. Trkal and F. Záviska. *J. de Physique et le Radium*, 4. *pp.* 269–277, *June*, 1933.—In a paper by Posejpal [see Abstract 5055 (1932)] it is suggested that light quanta can penetrate the structure of an atom only to a certain depth, and certain conclusions, which are claimed to show a good agreement with experiment, are reached. The present paper is concerned with showing in detail that the assumptions are erroneous and the agreement fortuitous. J. E. R. C.

4139. Topography of the Latent X-Ray Image. Lüppo-Cramer and H. Steps. *Zeits. f. wiss. Phot.* 32. *pp.* 113–128, *July*, 1933.—From a consideration of data already published it is shown that the increase of sensitivity of silver bromide emulsions with X-rays due to an exceptional after-ripening nucleus formation, without a simultaneous grain-size magnification is partly due to the ripening nuclei. These also partially account for the reduction in sensitivity to X-rays produced by desensitising dyes and chromic acid. These nuclei cannot be very deeply embedded in the silver bromide grains as they can be largely destroyed by chemical acid, as can also the latent X-ray image. Other results show that pure silver bromide emulsions are more sensitive to pure X-rays, that is without a focussing screen, than are similar emulsions containing silver iodide. No simple explanation can be offered for this, however, as the pure silver bromide emulsions have always considerably larger grains than have those containing silver iodide. R. C. F.

4140. Formation of Silver in Photographic Layers under the Influence of X-Rays. P. Günther and H. Tittel. *Zeits. f. Elektrochem.* 39. *pp.* 646–655 ; *Disc.*, 655, *July*, 1933.—The results obtained show that for the region of 0·245 Å–1·5 Å approximately 1200 k.cal. in the form of energy of exciting secondary electrons are necessary to precipitate 1 gramme-atom of silver from a particular type of Agfa film. An estimation of the chemical effect as quantum gain gives values the same as already obtained by Eggert and Noddack. Further, a comparison of the loss of secondary electron energy for the photographic plate reactions and for the primary reaction of X-rays on chloroform shows an agreement of that part which is used for the breaking down of the chemical bonds. R. C. F.

4141. Intensity of X-Ray Reflection. F. C. Blake. *Rev. Modern Physics*, 5. *pp.* 169–202, *July*, 1933.—The paper consists principally of a review of previously published work. Particular attention is paid to the powder method and the polarisation-, Lorentz-, temperature-, absorption-, structure-, atomic-form- and multiplicity-factors are fully discussed. Original work on the absorption factor and the testing of the intensity formula is presented. Work on the correct procedure in the interpretation of photometer records is also outlined. A comprehensive list of 77 references is given. J. T.

4142. Theory of Dispersion of X-Rays. H. Hönl. *Zeits. f. Physik*, 84. 1–2. *pp.* 1–16, *July* 17, 1933.—The Kallmann-Mark theory of dispersion for X-rays is improved by taking more exact account of the distribution of oscillators at the K-edge, and the new formula is compared with the dispersion measurements of Larsson. The number of dispersion electrons in the K- and L-levels is calculated for several elements. The results are in satisfactory agreement with experiment. C. B. A.

4143. Natural Widths of the Kα X-Ray Doublet from 26Fe to 47Ag. S. K. Allison. *Phys. Rev.* 44. *pp.* 63–72, *July* 15, 1933.—The full widths at half maximum of the Kα_1 and Kα_2 lines of 14 elements from 26Fe to 47Ag have been investigated with the double spectrometer in the (1, 1) position. The calcite crystals used had been previously studied in the (1, − 1) position and shown to give results agreeing well with those to be expected from a perfect calcite crystal. The reported widths are uncorrected for the effects of overlapping of the lines, vertical divergence of the X-ray beam, or diffraction pattern widths of the crystals. They are, in X units :

	26Fe	27Co	28Ni	29Cu	30Zn	32Ge	38Sr	40Zr	41Cb	42Mo	44Ru	45Rh	46Pd	47Ag
Kα_2	1·06	0·95	0·82	0·77	0·58	0·46	0·36	0·35	0·31	0·32	0·29	0·29	0·29	0·29
Kα_1	1·00	0·81	0·64	0·58	0·51	0·43	0·35	0·33	0·33	0·29	0·29	0·29	0·28	0·28

The Kα_1 lines of Fe, Co, Ni, Cu, Zn and Ge are definitely asymmetrical, the centre lying to the long wave-length side of the maximum ordinate. Pronounced difference in width of Kα_1 and Kα_2 and asymmetrical lines are found in and near the region of the periodic table where the $M_{IV}M_V$ shells are filling with electrons. AUTHOR.

4144. M-Levels of Magnetised Iron. Privault. *Comptes Rendus*, 197. *pp.* 140–142, *July* 10, 1933.—Using similar methods [see Abstract 2457 (1933)] the application of a field of 15,500 gauss to an iron kathode did not affect the wave-length of Kβ_1 and Kβ_2 by more than 0·03 and 0·06X, or the energies of the levels M_3 and M_5 by more than 0·2 and 0·4 respectively. C. A. S.

4145. Stimulation of X-Radiation by Canal-Ray Impacts. C. Gerthsen and W. Reusse. *Phys. Zeits.* 34. *pp.* 478–482, *June* 15, 1933. —It is of interest to determine the relation between the stimulation-probabilities of the Al_K– and the Se_L– radiations. A comparative count-and-reckoning method showed that the ratio was less than the ratio of the

K– and L– electrons. The absolute values are far more difficult to determine. Approximately for aluminium a yield of one quantum per 10^5 to 10^6 incident protons corresponds to an energy of 140 kV. A. D.

4146. Relative Intensities and Transition Probabilities of the K-Series Lines of the Elements 24 to 52 by the Ionisation Chamber Method. J. H. Williams. *Phys. Rev.* 44. *pp.* 146–154, *Aug.* 1, 1933.—Experiments on the ionisation currents produced by X-ray lines of wave-lengths 2·29, 1·93 and 1·66 Å entering a double ionisation chamber filled with methyl iodide, methyl bromide, argon, air, and sulphur dioxide have been carried out. The current ratios obtained when corrected for the fraction of the direct beam absorbed in the front chamber were found not to vary by more than 1·5 % in these gases. The conclusion is reached that the ionisation chamber is a suitable instrument for measuring relative intensities of X-ray lines of different wave-lengths in the region 0·4 to 2·3 Å. The relative intensities of the K-series lines of twenty elements from Cr (24) to Te (52) were examined under controlled conditions, and on correction for various factors yield a variation of relative intensity with atomic number. α_2/α_1 remains constant at approximately 0·50 throughout the range. β_1/α_1 rises steeply from a value of 0·161 at Co (27) to 0·274 at Sr (38) then less rapidly to 0·306 at Te (52). β_2/α_1 rises steeply from a value of 0·0036 at Zn (30) to 0·0450 at Zr (40) and then in a more linear fashion to 0·0735 at Te. Equations obtained from measurements on the absorption coefficients of various materials are: mica $\mu=36{\cdot}56\lambda^{2\cdot76}$ from 0·4 to 2·3 Å; cellophane $\mu=3{\cdot}52\lambda^{2\cdot66}$ from 0·6 to 2·3 Å; CH_3Br $\mu/\rho=19{\cdot}2\lambda^{2\cdot79}$ from 1·1 to 2·3 Å; CH_3I $\mu/\rho=65{\cdot}46\lambda^{2\cdot62}$ from 0·4 to 0·9 Å. A treatment is given and discussed for the absorption of the X-rays within the target. The resultant correction is small and on application to the observed relative intensities the ratio of the transition probabilities for the K-series lines of these elements is obtained. AUTHOR.

4147. Constant Deviation X-Ray Vacuum Monochromator. G. I. Harper. *Cambridge Phil. Soc., Proc.* 29. *pp.* 408–416, *July*, 1933.—An instrument is described which provides an accurately monochromatised beam of X-rays by reflection at a crystal and permits the wave-length to be changed without moving either the X-ray tube or the measuring apparatus. This is effected by an automatic adjustment which moves a second crystal into the correct position and orientation to reflect the monochromatised beam along a fixed emergent direction. Twenty wave-lengths well distributed in the range 0·8 Å–4 Å are available, the time required to select any one being about one minute. The whole instrument is contained in a small metal box which is evacuated. AUTHOR.

4148. Integrating Photometer for X-Ray Crystal Analysis. B. W. Robinson. *Journ. Sci. Instruments*, 10. *pp.* 233–242, *Aug.*, 1933.—The paper describes a photoelectric photometer, designed primarily for the measurement of integrated X-ray intensities in crystal analysis photographs, but adaptable to almost any form of X-ray photometry. It is simple to construct, in the sense that it could be built by any intelligent mechanic and involves no carefully finished parts. It is cheap, the only expensive item being the two photocells and amplifying valve; and its accuracy is adequate to the purpose for which it was designed. AUTHOR.

See also Abstracts 4035, 4199, 4200, 4222, 4274.

HEAT.

CALORIMETRY.

See Abstracts 4104, 4171.

CONDUCTION.

4149. Theory of Heat Conduction. B. Bružs. *Zeits. f. Physik,* 83. 7–8. *pp.* 543–553, *June* 28, 1933.—The assumption previously employed [see Abstracts 2167 and 5358 (1932)] that the heats of reaction appearing in stationary systems are to be regarded as latent heats has been further applied, and has enabled thermodynamical relations to be obtained for thermal molecular pressure and for the heat conducted in the case of stationary sublimation. Various thermoelectric effects are shown to be analogous. R. W. P.

4150. Measurement of Thermal Conductivity in Gases. M. Trautz and A. Zündel. *Ann. d. Physik,* 17. 4. *pp.* 345–375, *June* 19, 1933.—A method similar to that used by Eucken is described for measuring the thermal conductivity of gases. It is critically examined for sources of error and tests made on air, CO, CO_2, CH_4 and propane gave values which could be reproduced to within 1 %. It is thought that this is the first determination of the thermal conductivity of pure propane, the value obtained being $354 \cdot 9 \times 10^{-7}$ c.g.s. units. R. W. P.

4151. Conduction of Heat in Powders. W. G. Kannuluik and L. H. Martin. *Roy. Soc., Proc.* 141. *pp.* 144–158, *July* 3, 1933.—A description is given of a hot wire method of determining the thermal conductivity of powders in gases. As powders the following materials were used : glass spheres, diphenylamine, magnesium oxide, and a series of graded carborundum powders. These materials were immersed in turn in air, hydrogen, carbon dioxide and in some cases helium. The conductivities were measured over a range of pressures 0·5 cm. to 76 cm. It is found that the conductivity k can be expressed as a function of the pressure p by means of the relation $p/k = ap + b$. A simple derivation of this relation is given making use of the Fourier equation, and the temperature discontinuity at the gas-solid interfaces (temperature " Sprung "). Departures from this relation observed for some of the finer powders, and in general for all powders at low pressures, are explained by introducing the conception of molecular conduction. AUTHORS.

4152. Thermal and Electrical Conductivities of Several Metals. W. G. Kannuluik . *Roy. Soc., Proc.* 141. *pp.* 159–168, *July* 3, 1933.—An electrical method of obtaining the thermal and the electrical conductivity of a metal in wire form, previously developed and used by the writer [see Abstract 3865 (1931)], is extended so as to include observations between −183° C. and 100° C. The wires studied are tungsten (in monocrystal form), molybdenum, silver, and iron. The complete thermal and electrical data obtained are given. Optical spectroscopic analyses of the purity of the tungsten, molybdenum, and silver wires were made. The nature of the impurities and, in the case of molybdenum and tungsten, their probable amounts are given in an Appendix. AUTHOR.

See also Abstracts 3870, 4069.

DILATATION.

4153. Thermal Expansion of Refractories to 1800° C. R. A. Heindl. *Bureau of Standards, J. of Research,* 10. *pp.* 715–735, *June,* 1933. —The linear thermal expansions of the following 36 materials were measured: African chrome sand; Cuban, Grecian, Friable African, Rhodesian Imperial, Indian and Turkish chrome ores; Austrian, Californian, and electrically fused magnesites; a periclase brick; a spinel brick; two types of fire-clay bricks and two of fire clays; Kentucky, Tennessee, and English ball clays; Georgia kaolin and English china clay; an 80 % alumina brick; artificial corundum, diaspore, bauxite; five mullites, each of which was prepared from different raw materials; two zircon bricks and a furnaced zirconium silicate; silicon carbide, a silica brick, and an insulating brick. Data are also given on artificial graphite which had been preheated several times to 1800° C. Measurements were made below 1000° C. in both an oxidising and a reducing atmosphere. Above 1000° C. the materials were tested in a reducing atmosphere only. When the refractoriness of the materials permitted they were tested up to 1800° C. Petrographic analyses of the materials were made before and after the several heat treatments. AUTHOR.

See also Abstract 4085.

EVAPORATION.

4154. Theory of the Rate of Sublimation. S. Miyamoto. *Faraday Soc., Trans.* 29. *pp.* 794–797, *July,* 1933.—A theory is proposed, based on the assumptions that among the molecules which make up the solid surface, only those whose energies of vibrations at right angles to the interface exceed a threshold value can escape from the solid phase, and that among the molecules in the gas phase only those which collide with the interface with velocities whose components at right angles to the interface exceed a threshold value can condense on the solid surface. Expressions for the rate of sublimation and the vapour pressure of the solid are deduced. N. M. B.

MELTING AND BOILING POINTS.

4155. Thermal Properties of Alloys by the Difference Method. E. Alberti. *Zeits. f. techn. Physik,* 14. 7. *pp.* 281–283, 1933.—An apparatus is described for the accurate determination of the temperatures at which crystallisation commences in aluminium-barium alloys. The alloy is heated in an atmosphere of argon and can be cooled very slowly. G. G. S.

4156. Annealing of Glass as a Physical Problem. L. H. Adams. *Frank. Inst., J.* 216. *pp.* 39–71, *July,* 1933.—The fundamental principles underlying the annealing of glass are briefly reviewed. It is emphasised that a quantitative explanation of the formation and removal of strain in glass and a precise determination of the requisite conditions for any desired

degree of annealing, may be obtained on a purely mechanical basis, without consideration of the internal constitution of materials in the vitreous state. An improved definition of annealing time allows a simplification in the determination of the proper procedure for annealing. The best conditions for annealing, when the temperature differs from the most favourable temperature, are also discussed. It is shown that internal stresses can have no effect on the total volume or on the average density of a block of glass. Although unannealed glass may have an abnormally low density, the stresses themselves have nothing to do with this effect. The anomalies of glass in the annealing range. the relation between viscosity and rigidity, the physical basis of the rate of release of strain, and the possibility that glass at low temperatures may have a finite strength, are discussed.
W. D. W.

TEMPERATURE, MEASUREMENT OF.

4157. International Comparison of the Temperature Scale between 660° and 1063° C. W. F. Roeser, F. H. Schofield and H. A. Moser. *Ann.d.Physik*, 17. 3. *pp*. 243–250, *June*, 1933.—This is a description of a comparison of the temperature scales which have been in use since 1927 in the National Bureau of Standards, Washington, the National Physical Laboratory, Teddington, and the Physikalisch-Technische Reichsanstalt, Charlottenburg. It is shown that a difference of 0·7° at 850° existed, due to an error of 0·4° C. in the determination of the melting point of silver. After an exchange of silver samples and thermocouples, the results agree to within 0·1° C. throughout the temperature interval. Instruments were exchanged between the three laboratories, and calibrated according to the methods in use in the three places. Three types of instruments, *i.e.* resistance thermometers, thermoelectric couples and optical pyrometers, were necessary to cover the range. The work is hence divided into three sections, of which the one covered by thermocouples is the subject of this paper. The scale is defined and the method of measurement described. The results are given in tabular form. T. B.

4158. Freezing Point of Iridium. F. Henning and H. T. Wensel. *Bureau of Standards, J. of Research*, 10. *pp*. 809–821, *June*, 1933.—The ratio of brightness for red light of a black body immersed in freezing iridium to that of a similar black body immersed in freezing gold was measured both directly and indirectly. The indirect method consisted in determining the ratio of brightness at the iridium and platinum freezing points and calculating the result from the previously determined platinum to gold ratio. The two methods, agreeing with each other within experimental errors, yielded a value for the iridium to gold ratio of 4380 at wavelength 0·652 μ. This fixes the freezing point of iridium on the International Temperature Scale as 2454° C. AUTHORS.

4159. Molybdenum-Resistance Furnace of New Design. G. Burrows and F. L. Clark. *Journ. Sci. Instruments*, 10. *pp*. 248–250, *Aug*., 1933.—The design of a furnace utilising molybdenum-resistance strips is given. The maximum useful temperature is limited by the refractories which are at present of alumina and can be used continuously at temperatures up to 1850° C., and which may on occasion be used at even higher temperatures. An input of less than 2 kW is sufficient to raise the temperature to 1850° C. A major advantage of the design is the sturdiness of the heating elements, which have a long life compared with the molybdenum wire used in the more conventional types of furnace. AUTHORS.

See also Abstracts 3992, 4092, 4162, 4270.

THERMOCHEMISTRY.

4160. Heats of Combustion of CO in O_2 and of N_2O in CO at Constant Pressure. J. H. Awbery and E. Griffiths. *Roy. Soc., Proc.* 141. *pp.* 1–16, *July* 3, 1933.—The heats of combustion of N_2O and of O_2 in CO have been determined by the constant pressure method. An adiabatic calorimeter was used to measure the heat evolved. In addition, experiments were carried out in which CO was burnt in an excess of O_2. The extent of the reactions was found by absorbing and weighing the CO_2 produced. The heat capacity of the calorimeter and its contents was determined by generating a measured amount of energy in an electric heater in the calorimeter, and observing the corresponding temperature-rise. The result for the heat of combustion of CO in O_2 was found to be 282,730 joules per mole at 20° C. It is estimated that the value 282,730 should be right to within 3 parts in 1000. The result for the heat of reaction when N_2O burns in CO is 364,340 joules per mole. A discussion of the limiting accuracy suggests that this result also is reliable to 2 or 3 parts in 1000. From these two results, the heat of formation of N_2O at constant atmospheric pressure and at a temperature of 20° C. is found to be 81,610 joules, *i.e.* $19 \cdot 5_0$ k. cal._{15} per mole. This quantity is determined as the difference between two heats of combustion, which were carried out with the same apparatus used in the same manner for both sets of experiments. AUTHORS.

4161. Heats of Formation of N_2O and CO_2. R. W. Fenning and F. T. Cotton. *Roy. Soc., Proc.* 141. *pp.* 17–28, *July* 3, 1933.—A redetermination was required of the heat of formation of N_2O. By means of a bomb calorimeter, designed for the purpose, the heats of reaction of O_2 and N_2O in CO and H_2 respectively were measured. Thus, by difference, two values were obtained for the heat of formation of N_2O. Incidentally a value for the heat of formation of CO_2 from CO and O_2 was also obtained. Since the combustion of O_2 in H_2 formed the calibration process, all the values given are based on the acceptance of 68,320 gm. $\text{cal.}_{15}{}^{\circ}$ as the heat of formation of H_2O (liquid) at constant pressure and at 25° C. On this basis, the heats of formation of N_2O and CO_2 at a constant pressure of 1 atmosphere and at 20° C. were found to be $-19 \cdot 74 \pm 0 \cdot 07$ k. $\text{cal.}_{15}{}^{\circ}$ or $-82,600 \pm 290$ international joules, and $67 \cdot 65_5 \pm 0 \cdot 03_5$ k. $\text{cal.}_{15}{}^{\circ}$ or $283,090 \pm 150$ international joules respectively. AUTHORS.

4162. Temperatures of Inflammation of Detonating Gas at Atmospheric Pressure. Tauzin. *Comptes Rendus,* 196. *pp.* 1605–1607, *May* 22, 1933.—Temperatures of inflammation of gaseous mixtures have been measured by various experimenters, and the results have been of the same order whether the gas has been introduced quickly into a wide heated tube from a reservoir at atmospheric pressure, or ignited at low pressure. The author, using a quickly dried mixture of hydrogen and air, (with 30% hydrogen), has determined the region of inflammation of this mixture at low pressures. A curve representing the results shows

that at a pressure of about 1 cm. of mercury the gas is ignited at 430° C. At temperatures of 430° to 480° C. ignition takes place in an area bounded by two curves, one of which, representing about one cm. of mercury, is nearly horizontal, the other extending from 1 cm. (at 430° C.) to 4·7 cm. (at 480° C.). Above 480° C. the gas can be ignited at any pressure from a few mm. up to atmospheric. An explanation of the phenomena is given.
T. B.

4163. Experiments on Flame Movements in Gaseous Mixtures. C. Campbell, C. Whitworth and A. King. *Manchester Phil. Soc., Mem.* 76. *pp.* 45–52, 1931–1932.—Part I. Movement of Explosion Waves in Gases Contained in Tubes of Non-Uniform Diameter: The explosion wave in a gaseous mixture in a long tube is usually damped down at a point where an abrupt increase in the diameter of the tube occurs. It is shown that this lowering of velocity depends on the explosive mixture used. In some of the experiments described the velocities are measured along the arms of a T-shaped tube. With certain mixtures there is no change of velocity in either of the branching limbs of the tube; with other mixtures there is a fall in one limb only; and with a third group there is a damping down of the explosion wave in both limbs. It is observed that those mixtures which show this damping down all give well-defined striae. Part II. Pressure Conditions ahead of Flames: It is shown by visual and photographic means that when a gaseous mixture is ignited near the closed end of a horizontal tube, increased pressure conditions exist a considerable distance in front of slow flames, but not for any appreciable distance in front of detonation waves.
T. B.

4164. Upper Pressure Limit in the Chain Reaction between Hydrogen and Oxygen. G. H. Grant and C. N. Hinshelwood. *Roy. Soc., Proc.* 141. *pp.* 29–40, *July* 3, 1933.—The influence of H_2-O_2 ratio, inert gases, temperature, and surface and diameter of vessel on the upper pressure limit of the " low pressure " explosion of hydrogen and oxygen has been investigated. The results can be explained in terms of the theory that at the upper limit a branching chain process is balanced by gas phase deactivation in ternary collisions. On this basis the variation of the explosion pressure with H_2-O_2 ratio and with the pressure of inert gases present can be quantitatively accounted for. The mass of the two chain carriers concerned in the ternary collision must be considerably greater than that of two H atoms. The differing influence of temperature on the upper and lower limits is explained by the theory. The alternative views that the upper limit depends upon surface adsorption relationships or upon various thermal conductivities are inconsistent with the experimental observations.
AUTHORS.

4165. Influence of Pressure on Spontaneous Ignition of Inflammable Gas-Air Mixtures. Part I. Butane-Air Mixtures. D. T. A. Townend and M. R. Mandlekar. *Roy. Soc., Proc.* 141. *pp.* 484–493, *Aug.* 1, 1933.—An investigation has been made of the influence of initial pressure on the spontaneous ignition of various butane-air mixtures at pressure up to 15 atmospheres. At atmospheric pressure the ignition points fell from above 600° C. to *circa* 550° C. with increase in butane content in the mixtures and at 1½ atmospheres from *circa* 560° C. to 480° C. Further increase in pressure by only ½ atmosphere caused a lowering of the ignition points by no less than 130° C. to 140° C. for mixtures of butane content higher than *circa* $3\cdot5\,\%$; a similar sharp fall occurred with all other mixtures, the critical transition pressure then depending upon the composition of the mixture. The ignition points were found to lie in two well defined groups, the one, for determination *below* 3 atmospheres, located above 450° C. and the other, for determinations *above* 3 atmospheres, below 370° C. It is suggested that the higher group represents ignition points of the products of thermal decomposition of intermediate oxidation compounds, and the lower group those resulting from ignitions initiated in the primary combustion itself. The influence of lead tetraethyl in raising ignition temperatures is very much greater at the critical transition pressures than at atmospheric pressure, an effect which might be anticipated if the above view of the phenomenon be correct. AUTHORS.

4166. Quantum Mechanics of Chemical Reactions Involving Conjugate Double Bonds. H. Eyring, A. Sherman and G. E. Kimball. *J. Chem. Phys.* 1. *pp.* 586–592, *Aug.*, 1933.—The various theories of conjugate double bonds are discussed on the basis of quantum mechanics. The potential energy surfaces for the addition of diatomic molecules to such bonds are calculated by the generalised Heitler-London method. It is shown that various mechanisms are possible for such reactions and that such effects as the steric repulsions of the various inactive groups in the molecule and the nature of the catalytic surface on which such reactions often take place determine whether 1–2 or 1–4 addition takes place. AUTHORS.

See also Abstracts 3951, 4102, 4204.

THERMODYNAMICS.

4167. Equilibrium Diagram for Ternary System. V. Fischer. *Ann. d. Physik*, 17. 4. *pp.* 421–424, *June*, 1933.—A plane equilibrium diagram for ternary systems is described from which the equilibrium concentrations in liquid and vapour can be read off. As an example, a diagram of some isopiestics of the system oxygen-nitrogen-argon is given. G. G. S.

4168. Influence of Surface Energy in Disperse Systems. Chu-Phay Yap. *Phil. Mag.* 16. *pp.* 80–96, *July*, 1933.—The Gibbs phase rule is extended to cover cases in which one phase is in a state of subdivision, particle size not being necessarily constant. Pressure and temperature alone are insufficient to define the system so that $f = n - p + 3$. Examples are discussed, particularly with respect to metallic systems. A. S. C. L.

4169. Thermodynamic Studies of Mercurous Bromide. F. Ishikawa and Y. Ueda. *Tohoku Univ., Sci. Reports*, 22. *pp.* 249–262, *May*, 1933. *In English.*—The standard free energy change and the heat content change accompanying the formation of mercurous bromide have been determined by the measurement of the e.m.f. of the reversible cell containing this substance. From these results the entropy of mercurous bromide has been calculated and found to be in fairly good agreement with the calculated value by Latimer's equation. AUTHORS.

4170. Thermodynamic Studies of Cadmium Bromide. F. Ishikawa and Y. Ueda. *Tohoku Univ., Sci. Reports*, 22. *pp.* 263–287, *May*, 1933. *In English.*—The theoretical heat of solution of the hydrated cadmium bromide has been determined in two different ways resulting in a close agreement. The standard free energy change, the heat content change for the formation of and the entropy of the anhydrous cadmium bromide have been determined by measuring the e.m.f. of the reversible cells, the aqueous vapour pressure, and calorimetric heat of solution of this salt. AUTHORS.

4171. Heat Capacity Curves of the Simpler Gases. Part III. Heat Capacity, Entropy and Free Energy of Neutral OH. H. L. Johnston and D. H. Dawson. *Am. Chem. Soc., J.* 55. *pp.* 2744–2753, *July,* 1933.—The heat capacity of neutral OH has been calculated for the ideal gaseous state from 0·1° to 5000°K. Maxima occur at 0·06° and at 90°. Tables are given of entropy and total energies; also for the proportion of OH molecules at the various vibrational levels as a function of temperature. A. S. C. L.

4172. Thermodynamics of Very Rarefied Gases and Solutions. W. Nernst. *Preuss. Akad. Wiss. Berlin, Ber.* 13. *pp.* 467–470, 1933.—A discussion of the meaning of the course of various electrolytic processes. J. J. S.

See also Abstracts 3877, 3940, 3942, 3951, 4084, 4123, 4124, 4149, 4242, 4243.

VAPOUR PRESSURE.

4173. Vapours of Reciprocal Pairs of Salts and Binary Mixtures. B. Greiner and K. Jellinek. *Zeits. f. phys. Chem.* 165. *Abt. A.* 1–2. *pp.* 97–120, *June,* 1933.—The vapour pressures of the following salts are determined by application of a method previously described by Jellinek and Rosner [see Abstract 699 (1930)]: NaCl, KCl, NaI and KI at 1180°C.; $PbCl_2$ at 760° and 770°C.; PbI_2 at 760° and 800°C.; CuI at 800°C.; and $CdCl_2$ and $CdBr_2$ at 752°C. Measurements of the partial vapour pressures and activities of the separate components of the binary mixtures NaCl, KCl; NaI, KI; NaCl, NaI and KCl, KI show that these mixtures approximate to ideal solutions. Results are also given for measurements on the reciprocal pair of salts NaCl, KI at 1180°C., and the binary mixtures $PbCl_2$, $PbBr_2$ at 770°C.; $PbCl_2$, PbI_2 at 760°C.; PbI_2, CuI at 800°C. and $CdCl_2$, $CdBr_2$ at 752°C. In the case of these binary mixtures the formation of compounds in the vapours prevented the determination of the partial pressures and activities. R. W. P.

4174. Vapour Pressures and Activities of Binary Metallic Alloys. E. Burmeister and K. Jellinek. *Zeits. f. phys. Chem.* 165. *Abt. A.* 1–2. *pp.* 121–132, *June,* 1933.—The transference method of Jellinek and Rosner [see Abstract 699 (1930)] is modified and examined for a possible source of error at slow speeds of gas flow. Determinations of the vapour pressures of pure Cd at 683°C. and pure Zn at 681°C. show that when H_2 is used its velocity should be at least 5 cc. per min., whilst with N_2 a velocity of between 1 and 2 cc. per min. is necessary. The latter method is applied to measure the partial vapour pressures and activities of Cd over Sn-Cd-alloys at 540°C., of Zn over Sn-Zn-alloys at 684°C., and of Cd and Zn over Cd-Zn-alloys at 682°C. The values are in good agreement with those obtained by Taylor from e.m.f. measurements. An indirect method is given for the analysis of Cd-Zn-alloys. R. W. P.

See also Abstract 4154.

ACOUSTICS.

4175. Theory of Sound Absorption in Porous Walls. L. Cremer. *E.N.T.* 10. *pp.* 242–251, *June*, 1933.—The theory of sound absorption in porous walls starts from the assumption that the wall itself remains rigid and that it has no temperature effect on the enclosed air. A porous medium with layered structure is first considered and it is shown that with varying incidence the sound absorption increases to a maximum and then sinks to zero. The value of the maximum is independent of the porosity of the wall, reaching a value of 100 % for high frequencies and not falling below 83 % for low frequencies. Similar results are found for unlayered porous walls for low frequencies. For high frequencies the absorption is found to be independent of the angle of incidence and increases with the porosity. The application of the results to porous walls of finite thickness depends on an inequality which is more nearly fulfilled the thicker the wall, the higher the frequency and the greater the angle of incidence. A. W.

4176. Amplitude and Phase of Octave in Tuning Forks. B. Derjaguin. *Phys. Zeits. d. Sowjetunion*, 3. 6. *pp.* 574–585, 1933. *In German.*—Three forks of frequencies 64,128 and 256 were arranged so that the Lissajous figures for the octave and double octave could be observed. All three forks were set slightly out of tune, and sounds from the two higher forks were received in a Quincke apparatus adjusted to quench the fundamental of fork 128, and leave its octave audible. All three forks were sounded and the times measured between the events : minimum loudness of beats between octave of fork 128 and fundamental of 256 ; instant of completion of Lissajous figure by fork 128 ; corresponding moment for fork 256. The periods for the complete cycles of the figures were also noted. Measurements with the two higher forks gave the amplitudes of the fundamental and its octave, and experimental confirmation was obtained for Lindig's theory [see Abstract 1408 (1903)] that the phase difference of the fundamental and its octave at any point near the prongs is zero, and that the amplitude and intensity of the octave are proportional to the square of the respective amplitude and intensity of the fundamental.

G. E. A.

4177. Velocity of Sound at Low Temperatures. A. van Itterbeek. *Rev. d'Acoustique*, 2. *pp.* 81–97, *March*, 1933.—A detailed description of the experimental methods employed by W. H. Keesom and the author for the determination of the velocity of sound in He, H_2 and O_2 at low temperatures. Temperatures were measured by a platinum thermometer and the frequency of the source was determined by registering on a rotating drum the vibrations of an Einthoven galvanometer, placed in the oscillator circuit, beside those of a tuning fork. For experiments at the boiling point of oxygen a modification of Quincke's method was employed, in which the length of tube is altered until resonance is obtained. When cooling the apparatus with liquid hydrogen a spontaneous emission of sound took place necessitating, for mechanical reasons, the employment at lower temperatures of a resonator of constant length and a source whose frequency was varied until resonance resulted (Thiesen's method). The modification of the apparatus necessary to determine the theoretically

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important variation of velocity with pressure is described and the paper concludes with a note on the resonator wall and end corrections. E. J. I.

4178. Velocity of Sound in Air. M. Grabau. *Acoustical Soc. of America, J.* 5. *pp.* 1–9, *July*, 1933.—This study of the velocity of sound in air involves the use of the magnetostriction oscillator in an experiment similar to those of G. W. Pierce and others, who used piezoelectric crystals as sources of sound. The wave system generated by the source is investigated by observing the reactions of the source when the sound waves are reflected back upon it from a movable reflector. The range of frequencies used extends from 20,000 to 70,000. The irregularities of the wave system near the source are studied in some detail. It is found that these irregularities vary with the frequency, as well as with the diameters of both the source and the reflector, and that they vanish at relatively large distances from the source. The values of the velocity of sound then obtained show no variations with respect to the frequency. [See Abstract 2881 (1930).] AUTHOR.

4179. Velocity of Sound in Gases in Tubes. G. W. C. Kaye and G. G. Sherratt. *Roy. Soc., Proc.* 141. *pp.* 123–143, *July* 3, 1933.—The velocity of sound at 18° C. and 100° C. has been determined by the resonating-tube method in six different gases contained in six tubes of adjustable length and of different diameters and materials (glass, copper and carbon). A series of frequencies from 500 to 27,000 ∼ were provided by a valve-oscillator system controlled by a vibrating quartz crystal which also served as a resonance detector. For all the gases the Helmholtz-Kirchhoff formula is quantitatively correct in its statement of the influence of tube diameter and frequency on the velocity. The formula does not, however, take cognisance of the influence of the wall surface. In the smooth tubes the reduction in velocity below the free-space value was on the average about 10 % less and in the rough tubes about 30 % more than the formula would indicate. An examination of the literature indicates that much of the criticism to which the Helmholtz-Kirchhoff formula has been subjected in the past was unjustified. Free-space velocities for the pure dry gases are deduced from the observations. The probable accuracy is of the order of 1 in 1000 except for hydrogen, where it may be a little less. AUTHORS.

4180. Meteorological Acoustics. W. S. Tucker. *Roy. Meteorolog. Soc., J.* 59. *pp.* 203–216, *July*, 1933.—In this paper the author, after referring to some of the earlier methods of sound location, proceeds to deal with more recent methods by first defining what is termed the " acoustical field." The direction of sound rays in such a field is determined by the distribution of temperature and of wind velocity within the field. Some simple cases are considered, *e.g.*, the path of sound rays in still air which is also in convective equilibrium. In such the rays are catenaries. The case where wind velocity increases with height is also referred to. A suggested method of treatment of the acoustic field is that of measuring its deviation from the visual field. The nature of these deviations arising from varying meteorological conditions is then considered in detail. Such investigations have resulted in the construction of sound locators able to detect with sufficient accuracy a fixed continuous source. The problem of attenuation of sound in the atmosphere yet awaits solution. It is suggested that acoustical observations may yet prove very useful in the meteorological service. A. E. M. G.

4181. Study of Reverberation of Sound by Means of an Automatic Apparatus. M. J. O. Strutt. *Rev. d'Acoustique,* 2. *pp.* 1–26, *Jan.,* 1933.—By means of an apparatus automatically recording the time of reverberation in a room the author has investigated the validity of Sabine's fundamental postulates. The apparatus and the method employed to eliminate stationary effects (interruption of emission and rotation of source) are described and the following conclusions are drawn: 1. In a hall of simple form of a volume of 1500 cu.m. Sabine's first law (duration of reverberation independent of positions of source and receiver) holds exactly: for smaller halls (200–400 cu.m. volume) it is true to within 10 %. 2. The law requires modification when (*a*) the hall is put into communication with an annexe of different absorption, (*b*) one of the walls is covered with absorbing material which is set into vibration by the sound, and (*c*) the absorbing powers of the materials covering different walls of a small hall are unequal. From his experiments the author concludes that distortion introduced by selective reverberation will not be perceptible to the ear. E. J. I.

4182. Electrical Reproduction of Sound. P. Toulon. *Rev. d'Acoustique,* 2. *pp.* 126–133, *March,* 1933.—A qualitative discussion on fidelity of reproduction. E. J. I.

4183. Tactual Perception of Musical Intervals. L. D. Goodfellow. *Frank. Inst., J.* 215. *pp.* 731–736, *June,* 1933.—A report of the ability of persons to recognise musical intervals by touch. The intervals of fifth and octave, minor second and major seventh were recorded in random order on victrola records, and the observers were twenty persons with normal hearing. To feel the vibrations the observer's arm was inserted into a sound-eliminating box which contained the vibrator. At first, both tactual and auditory identification of the intervals was tested, next the effect on tactual identification due to ear training, and last the effect on the ability of the ear due to training in tactual identification. It is concluded that the perception of musical intervals is a central process rather than a function of the receiving sense organ; also, through the senses of touch and vibration two tones sounding simultaneously can be perceived; and a very close relationship exists between hearing and the more primitive senses of touch and vibration. G. E. A.

4184. Logarithmic Recorder for Frequency Response Measurements at Audio-Frequencies. S. Ballantine. *Acoustical Soc. of America, J.* 5. *pp.* 10–24, *July,* 1933.—An automatic recorder to facilitate obtaining irregular frequency response characteristics has been developed. It employs photographic registration and is capable of rapidly following wide fluctuations in amplitude. Both frequency and amplitude scales are logarithmic. G. G. S.

4185. Estimation of Fractional Loudness. P. H. Geiger and F. A. Firestone. *Acoustical Soc. of America, J.* 5. *pp.* 25–30, *July,* 1933.—Two previous papers, one by Ham and Parkinson [see Abstract 3832 (1932)] and the other by Laird, Taylor and Wille [see Abstract 2502 (1932)] have discussed the change in physical intensity necessary to produce certain fractional or multiple changes in apparent loudness. While the experimental work in each case appears to be equally reliable there are large divergences between the results of the two investigations. The present paper is concerned with a further investigation of the problem and,

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incidentally, attempts to explain the divergences noted above. It is found that the intensity change necessary to produce a given change in apparent loudness depends upon the frequency and the initial intensity. It is also noted that the intensity change producing a given fractional loudness change is different from that producing the corresponding multiple loudness change. It is deduced from certain considerations that loudness judgments are made upon the basis of actual observation. J. E. R. C.

4186. Portable Meter for Noise Measurement and Analysis. W. O. Osbon and K. A. Oplinger. *Acoustical Soc. of America, J.* 5. *pp.* 39–45, *July,* 1933.—This paper describes (1) a portable noise meter, the development of which is based upon several years' experience in the field of industrial noise measurements ; (2) a new superheterodyne analyser attachment for the noise meter which permits analysis of noises with a high degree of selectivity, and (3) a moving coil type of pick-up for making vibration measurements. The principal considerations in the design of the various units have been ruggedness, simplicity of operation, portability, and accuracy. A general discussion of the factors involved in the design and use of noise measuring instruments is given. AUTHORS.

4187. Electrical Methods for Production and Measurement of Musical Frequencies. P. Nicolas. *Rev. d'Acoustique,* 2. *pp.* 98–115, *March,* 1933.—The advantages of electrical methods for frequency determinations are discussed, and methods which may be classified under the following headings are then described : (1) Direct comparisons ; (*a*) stroboscopic methods of limited applicability, (*b*) observation of " beats " performed by the needle of an electrical instrument vibrating under the combined action of currents of known and unknown frequency—the former being obtained from either an elementary alternator (frequency equals number of " teeth " times speed of rotation), or a valve oscillator standardised by one of the methods indicated. (2) Comparisons employing electrical standards. As an example the " Robinson bridge " is described. In this the third and fourth arms of a Wheatstone bridge, fed by the source of unknown frequency, consist of resistances placed in series and in parallel respectively with capacities. The frequency is determined from the magnitude of the electrical quantities required for a balance. (3) Methods based on both (1) and (2) above, *e.g.,* by the use of a "Robinson bridge " arrangement to measure the frequency of beats generated by two notes of known and unknown frequency. E. J. I.

4188. Fundamental Sound Generated by Airscrew of Aeroplane in Flight. E. T. Paris. *Phil. Mag.* 16. *pp.* 50–61, *July,* 1933.—Describes the measurement of the amplitude of the fundamental tone generated by the airscrew of an aeroplane flying 1000 ft. above the receiving instrument which consisted of a resonant hot-wire microphone. A Moll galvanometer was used in recording resistance changes in the microphone grid, and an Einthoven for determining the frequency of the sound. With an engine speed of 1850 r.p.m. that of the airscrew was about half as much, and the frequency of its fundamental was 29. The acoustic output of the airscrew in flight was calculated at 55 watts, and it appears to be greater in flight than at zero rate of advance. G. E. A.

4189. Propagation of Sound Along the Slipstream of an Airscrew. E. T. Paris. *Phil. Mag.* 16. *pp.* 61–64, *July,* 1933.—Observations on the distribution of the second harmonic of the exhaust indicate that the sound propagated along the slipstream of the airscrew in the direction of motion of the air becomes rapidly attenuated. The propeller rotated in a vertical plane in a fixed fuselage from which wings, tailplane and rudder had been removed. The two exhaust outlets were symmetrically placed on each side of the median plane of the fuselage, and lay within the slipstream. The effect of the slipstream is to divert sound energy from the backward direction and to send it out to the sides. G. E. A.

4190. Sound Output of a Grand Piano. E. Lübcke and K. H. Wernicke. *Hochfrequenztechn. u. Electroakustik,* 41. *pp.* 212–214, *June,* 1933.—The sound output of a grand piano in a room 6·75 m. × 6·0 m. × 4·0 m. high, was measured for individual notes throughout the compass with the piano lid open and closed, and with hard and medium striking of the keys. The results are shown in diagrams. A study was also made of the spacial distribution of energy in the room and of the dependence of the total absorption on the frequency. The curve for the latter shows at first a gradual rise, but the slope increases rapidly as the frequency approaches 5000. The values for the sound output of the individual notes were found to lie between 0·2 and 10 mW. The sound spectrum could be qualitatively produced in another empty room, so that the measuring apparatus can safely be used for further investigations to be carried out. The spectrum itself and the causes of the power differences observed are briefly discussed. A. W.

4191. Stroboscopic Demonstration of Tones. W. Anderson and H. Lowery. *Journ. Sci. Instruments,* 10. *pp.* 203–204, *July,* 1933.—The apparatus described is a modification of E. W. Scripture's "Strobilion." The acetylene gas flame illumination is replaced by a neon lamp connected in a suitable circuit with a microphone and valve amplifier. AUTHOR.

4192. Transmission Loss Through Partition Walls. E. H. Bedell and K. D. Swartzel, Jr. *Acoustical Soc. of America, J.* 5. *pp.* 34–38, *July,* 1933.—This paper reviews the theory and describes the method used at Bell Telephone Laboratories of measuring the transmission loss through partition walls. The partition to be tested is built into an opening between two adjacent but structurally isolated rooms. A loudspeaker acts as a source of sound in one room and a portion of the sound energy is transmitted into the second room through the test partititon. The transmission loss is taken as $TL = L_1 - L_2 - 10 \log_{10} (a_2/A)$, where L_1 and L_2 are the intensity levels in the source and test room respectively, expressed in db, a_2 is the absorption in the test room and A is the area of the partition. The levels L_1 and L_2 are measured and plotted with a moving coil microphone and an automatic level recorder, and a beat frequency oscillator is used as a source of tone so that the frequency may be varied continuously. Measurements with a continuous variation in frequency enable resonances in the partition to be much more easily and quickly detected than is possible when measurements are made at discrete frequency intervals. Both pure and frequency modulated tones have been used for the measurements. Results of measurements on a few partitions are given. AUTHORS.

See also Abstracts 4287, 4288, 4292.

ELECTRICITY AND MAGNETISM.

CONDUCTION AND DISCHARGE IN GASES.

4193. Electric Breakdown of Gases at Normal Pressure. J. J. Sämmer. *Zeits. f. Physik,* 83. 11–12. *pp.* 814–831, *July* 8, 1933.—It is shown how, with the help of the clouds of electrons formed from the primary electrons, a gas at normal pressure can be caused to glow, although the charge-density of the clouds is considerably decreased by the mutual repulsion of the electrons. This succeeds on account of the concentrating effect of the positive space-charges produced by collisions. An explanation is given of the spreading of the glow towards the kathode. It is assumed that new primary electrons are produced by a photoelectric effect of the already glowing part of the gas. The canal-shaped form of the discharge is discussed; this is explained from the relation between the coefficient of ionisation α and the field-strength E. J. E. K.

4194. Deposition of Sputtered Films. R. W. Ditchburn. *Roy. Soc., Proc.* 141. *pp.* 169–188, *July* 3, 1933.—(1) It is shown that in the deposition of sputtered cadmium there is no critical density phenomenon similar to that found by various authors for the condensation of vapour. For insulated surfaces the rate of deposition is very little affected by temperature changes from +30° C. (or more) to −150° C. (2) The rate of deposition is affected by the conditions of the discharge and by the potential of the target, being faster for surfaces which are collecting slow positive ions (order of 10 volts), somewhat slower for those collecting fast positive ions (order of 100 volts), and almost indefinitely slow for surfaces collecting electrons. (3) The rate of deposition on surfaces collecting electrons can be greatly accelerated by cooling. (4) It is shown that the deposition of boiled cadmium can be affected very strongly by a feeble discharge, and effects exactly parallel to those mentioned in (2) are found. (5) The sputtered metal giving these effects is shown to be uncharged. (6) Experiments on the thickness and structure of the film are described. (7) A tentative theory is suggested according to which the deposition is assisted by a surface cleaning effect of positive ions. AUTHOR.

4195. Ionisation of Air and Hydrogen in H.F. Discharge. T. V. Ionescu and Irène Mihul. *Comptes Rendus,* 196. *pp.* 1873–1875, *June* 19, 1933.—The discharge tube used was 1 m. long and 4 cm. diameter and contained a glass stopper. At one end of the tube two platinum wires were sealed in 2 mm. apart. These were connected to a 4-volt battery and a galvanometer, the galvanometer current being assumed to be proportional to the ionisation in the tube. The ionisation was produced by two plates on either side of the tube and at the same end as the sealed-in wires, the plates being connected to a valve generator. A study was made of the ionisation as a function of the gas pressure and of a magnetic field parallel to the axis of the tube. At a pressure of 0·001 mm. of Hg, in air or H, with moderate or powerful excitation of the plates, a feeble light appears between them and the oscillator ammeter shows a very small current. On raising one of the plates an intense light suddenly appears and extends for a length of 40 to 100 cm., the oscillator ammeter now showing 0·1 to 0·4 ampere. On replacing the plate in its original position the intensity of the light increases and the luminous column is shortened. On moving the glass stopper near to the luminous column stationary waves are formed which are doubtless those observed by Chenot [see Abstract 2781 (1931)]. The corresponding velocities of propagation lie between 10,000 and 40,000 km./sec. Curves are given showing the variation of the ionisation with magnetic fields up to 100 gauss. Different effects are observed at a pressure of 0·1 mm. of Hg. The results are briefly discussed. [See also Abstract 3731 (1933).] A. W.

4196. H.F. Discharge. (Miss) M. Chenot. *Comptes Rendus*, 196. *pp.* 1973–1975, *June* 26, 1933.—In previous papers [see Abstracts 2781 (1931) and 2077 (1933)] a description has been given of the phenomena of the propagation of electron movements in a tube containing gas at low pressure excited by a discharge of very high frequency. Further experiments on the stationary wave-systems obtained with the apparatus previously used confirm the theory which has been given to explain the phenomena. A. W.

4197. H.F. Discharges in Argon. Part II. Spectral Properties. S. P. McCallum, L. Klatzow and J. E. Keyston. *Phil. Mag.* 16. *pp.* 193–197, *July*, 1933.—A strong continuous spectrum is emitted by a h.f. discharge in pure argon at pressures from 1 mm. to 150 mm. This spectrum cannot be due to recombination of electrons with positive ions of argon. From consideration of the electric forces in the discharge it appears that the excitation potential of the continuous spectrum is not greater than 7 or 8 volts and may be much less. Comparison of the spectra emitted under various conditions by argon and helium leads to the conclusion that in h.f. discharges the distribution of the energies of the electrons about the mean energy is much narrower in argon than in helium; this is theoretically explained as a consequence of the variation of the mean free paths of the electrons with their velocity. [For Part I see Abstract 2537 (1933).] J. E. K.

4198. Ionisation of Mercury Vapour by Positive Ions. R. M. Chaudhri. *Roy. Soc., Proc.* 141. *pp.* 386–397, *Aug.* 1, 1933.—A method is described by which the ionisation of Hg vapour by Hg$^+$ and K$^+$ ions of moderate energies has been investigated. This method is shown to be free from many of the defects which existed in the methods of previous workers. It has been shown that Hg$^+$ ions ionise with greater efficiency than K$^+$ ions of the same kinetic energy. It is hoped to continue the experiments and extend their range. AUTHOR.

4199. Excitation of X-Rays by Collision of High-Velocity Positive Ions. K. Lion. *Zeits. f. Physik*, 83. 7–8, *pp.* 431–441, *June* 28, 1933.—With the help of a specially designed positive-ray tube ionic currents up to 5 mA and 150 kV are obtained. It is shown photographically that X-rays are produced when the ions are made to impinge on a metal plate by the action of a magnetic field. Absorption measurements in aluminium indicate a wave-length greater than 6 Å for this radiation. The possibility of it having its origin in some other source is discussed. The use of the magnetic field, in the absence of which no X-radiation is observed, makes it impossible for electrons to reach the anti-anode, nor could other X-rays be the cause, whilst ultra-violet light or charged or uncharged particles are prevented from reaching the photographic plate by an aluminium screen. A pin-hole camera photograph shows definitely that the X-rays come only from the point of impact of the positive ions on the metal plate. C. B. A.

4200. Doppler Effect in Hydrogen at High Voltages. K. Lion. *Zeits. f. Physik*, 83. 7–8. *pp.* 442–443, *June* 28, 1933.—By means of the high-voltage positive-ray tube described elsewhere [see preceding Abstract] it is shown, by investigation of the Doppler effect in hydrogen, that the velocity of the ions in the tube continues to increase with the applied potential up to voltages of 1130 kV. C. B. A.

4201. Potential Theory Applied to the Wehnelt Cylinder. G. Wendt. *Ann. d. Physik*, 17. 4. *pp.* 445–459, *June*, 1933.—By replacing the Wehnelt cylinder in kathode-ray tubes by simple geometrical configurations the penetration factor (*Durchgriff*) of the anode through the Wehnelt electrodes may be determined, and also the potential distribution along the axis. In the vicinity of the axis the potential field may be represented by means of an expansion in series. The Wehnelt electrodes are shown to exert a concentrating action on the electronic beam. H. L. B.

4202. Formation of Pictures of Surfaces Irradiated by Electrons in the Electron Microscope. E. Ruska. *Zeits. f. Physik*, 83. 7–8. *pp.* 492–497, *June* 28, 1933.—A description is given of the arrangement of a magnetic electron microscope for the observation of surfaces exposed to incident electron radiation, and illustrations are given showing that the use of this kind of electron microscope also gives pictures of such surfaces. Possibilities of improvement of the method are considered. [See Abstract 3740 (1933).] J. J. S.

4203. Focussing of Kathode-Ray Beams of Large Cross-Section. E. Ruska. *Zeits. f. Physik*, 83. 9–10. *pp.* 684–697, *July* 6, 1933.—Simple geometrical arrangements are suggested by means of which a beam of kathode rays of large initial cross-section may be brought to a focus. The path of the rays and the size of the focus in the various arrangements are calculated on the assumption that the electrons from the surface of the kathode diffuse and travel with velocities which are distributed over a known range. Four systems are considered in which the kathode and anode surfaces are (1) plane, (2) spherical convex, (3) spherical concave, and (4) cylindrical. The paper deals with the subject purely theoretically, but suggestions are made in conclusion for the practical application of the deductions. A. B. W.

4204. Formation of Metallic Hydrides by Atomic Hydrogen. E. Pietsch. *Zeits. f. Elektrochem.* 39. *pp.* 577–586; *Disc.*, 586, *July*, 1933.—The experiments now described have shown that the elements Ag, Cu, Au, Be, Ga, In, Ta, can form salt-like hydrides by means of atomic hydrogen when other forms of active hydrogen are unsuccessful. In every case the presence of ions and their valency can be determined analytically. The stoichiometric compositions of such compounds have hitherto not been determined since pure products have not been available, but with the present methods this objective may be attained eventually. In the case of indium, an insight into the mechanism of the reaction has been afforded, and this may possess general significance for hydride formation, since energy considerations are introduced. The determinations of the decomposition pressures and heats of dissociation of the hydrides of silver and tantalum possess similar characteristics, and measurements of the Röntgen structures are in progress. H. H. Ho.

4205. Atomic Chlorine. G. M. Schwab and H. Friess. *Zeits. f. Elektrochem.* 39. *pp.* 586–594 ; *Disc.*, 594, *July*, 1933.—An apparatus is described for the electrical production of atomic chlorine, wherein, during discharges, the appearance of two related groups of emission lines have been observed during the production of the atoms. The limiting period of existence of atomic chlorine, due to heterogeneous recombination, has been determined. Measured calorimetrically, the atomic concentration can amount to 40 %. Catalytic recombination has been investigated for numerous materials, *e.g.*, glass, oxides, metals, etc., and it has been established that no appreciable heat of activation is necessitated. The influence of different gases, such as oxygen, hydrogen, carbon monoxide, chloroform and nitrous oxide, has been studied, and the following chain-mechanisms are suggested : $Cl + H_2 = HCl + H$, $H + Cl_2 = HCl + Cl$; $Cl + CH_4 = HCl + CH_3$, $CH_3 + Cl_2 = CH_3Cl + Cl$; $Cl + CO + Cl_2 = COCl_2 + Cl$ (intermediate reaction unknown); $Cl + CHCl_3 = HCl + CCl_3$, $CCl_3 + Cl_2 = CCl_4 + Cl$. H. H. Ho.

4206. New Experimental Arrangement for the Production of Fast Ions. H. Kallmann. *Preuss. Akad. Wiss. Berlin, Ber.* 12. *pp.* 451–460, 1933.—With a suitable arrangement of h.t. transformer, valves and condensers, a split source of constant potential of + 275,000 and − 275,000 V delivering a maximum current of 6 mA is obtained. A special discharge tube is described in which the charge on the ions could be controlled. Currents of lithium ions are obtained of 3×10^{-6} ampere at $5{\cdot}5 \times 10^5$ V, of 3×10^{-9} ampere at $1{\cdot}1 \times 10^6$ V and of 10^{-10} ampere at $1{\cdot}65 \times 10^6$ V. The arrangement is convenient for rapid use in conjunction with electrical counters or the expansion chamber. F. C. C.

4207. Vacuum Discharge with Internal Source of High Potential. W. Kossel and A. Eckardt. *Ann. d. Physik.* 17. 5. *pp.* 543–552, *July*, 1933.—To obtain hard radiations without great demand for laboratory space it is necessary to transform to the highest potentials on a conductor in a vacuum. Special arrangements are devised for this purpose giving potentials up to 300 kV. F. C. C.

4208. Positive Lichtenberg Figures. S. Etinger. *Phys. Zeits.* 34. *pp.* 522–525, *July* 1, 1933.—By use of a specially built discharge apparatus very simple Lichtenberg figures were obtained on oscillograph paper. It was thus found possible to investigate the form of the figures under different conditions of production. The figures were found to be changed in a characteristic manner when they were recorded on a moving paper strip. The results indicate that the surface charges on the paper play a large part in determining the form the figures take. A. W.

See also Abstracts 3895, 3896, 4023, 4038, 4066, 4095, 4106, 4221, 4296, 4297, 4298.

CONDUCTION IN SOLIDS AND LIQUIDS.

4209. Part Played by Protons in Electrical Conduction in Metals. Part III. Photographic Plate as Indicator. A. Coehn and K. Sperling. *Zeits. f. Physik,* 83. 5–6. *pp.* 291–312, *June* 20, 1933.—It is shown that a Pd wire, charged with H_2, produces an image when laid on a photographic plate. This fact is used to study the rate of diffusion of H_2 along the wire and its variation with temperature over the range 15° C. to 45° C. The rate of diffusion is found to be greater in hard than in soft

Pd, and to decrease with increase of Ag, when Pd is alloyed with upwards of 20 % Ag. When an electric current is applied the photographs show the movement of H_2 towards the kathode, and by aid of subsidiary electrical resistance measurements the ratio of the number of protons to electrons is deduced. The ratio is found to be of the same order for the large potential drop at the point of contact of a wire and a plate as for a homogeneous wire. Experiments with other metals containing H_2 show that Al, Fe, Ni and Pb produce images on the plate, but that Cr, Ta and Pt do not. [For Part II see Abstract 189 (1932).] R. W. P.

4210. Electronic Properties of Conductors and Insulators. R. H. Fowler. *Roy. Soc., Proc.* 141. *pp.* 56–71, *July* 3, 1933.—The paper is a critical survey of certain current views on the nature of crystalline insulators and their electronic properties. In particular Tamm's theory of surface levels on an insulator is analysed and is shown not to be of importance in the theory of the passage of current through the insulator. It is shown that the necessary charges at an interface between a metal and a crystal can always be accommodated in the metal at levels very close to the top of the Fermi-Sommerfeld distribution. The manner in which a poorly conducting crystal carries a current between metal electrodes is also discussed, and the results of the discussion are applied to the properties of crystals rendered conducting by light. It is suggested that certain experiments on photo-conductivity should be carried out for constant illumination by a technique which uses no electrodes and creates no space charges in the crystal. The type of theory which should apply to such cases is briefly outlined. AUTHOR.

4211. Theory of Regular Mixed Phases. Part III. C. Wagner. *Zeits. f. phys. Chem.* 22. *Abt. B.* 3. *pp.* 181–194, *July,* 1933.—The paper deals with the theory of electronic and ionic conduction in mixed phases. It is suggested that electronic conduction may occur either through the agency of excess electrons or of a deficiency in the number of electrons. In the latter case the conduction is rendered possible by the progressive movement of electrons into gaps in the electronic lattice of the crystal. The theory indicates that the two types may be distinguished by the fact that for excess electrons the conductivity should decrease with increase in the partial pressure of the electronegative component, whereas the change should be of opposite sign for a deficiency of electrons. Independence of the conductivity on the partial pressure of the electronegative component is explained by equivalent concentrations of free electrons and of spaces in the electronic lattice. Ionic conduction is attributed to the equivalence of the concentrations of kations or anions between the lattices and of spaces in the respective ionic partial lattice. R. W. P.

4212. Theory of Thermoelements Composed of Semi-Conductors. C. Wagner. *Zeits. f. phys. Chem.* 22. *Abt. B.* 3. *pp.* 195–198, *July,* 1933.—A theory is developed for the e.m.f. of a thermojunction, composed of two rods of the same semi-conductor but possessing different electronic conductivities. The sign of the e.m.f. is found to differ according to whether the electronic conductivity is due to an excess or a deficiency of electrons [see preceding Abstract.] R. W. P.

4213. Electrical Conductivity of Zinc Oxide and Cadmium Oxide. H. H. v. Baumbach and C. Wagner. *Zeits. f. phys. Chem.* 22. *Abt. B.* 3. *pp.* 199–211, *July,* 1933.—Measurements of the electrical conductivity of several rods of ZnO and CdO are described. The rods were preheated to about 900° or 1000° C., and tests over the approximate range 400° to 700° C. showed that the conductivity of both oxides increases with increase in temperature. Decrease in the pressure of the oxygen also resulted in an increase in the electrical conductivity. The effect is represented by the empirical relation $\sigma = p^{-\frac{1}{n}}$ constant, where σ = conductivity, p = oxygen pressure, and n varied for different specimens, being about 4·3 for ZnO and 6 or 7 for CdO (a rod only preheated to 550° C. gave a much higher value). The conductivity of a rod of ZnO maintained at 650° C. increased from $2 \cdot 6 \times 10^{-3}$ to $2 \cdot 4$ ohm^{-1} cm.$^{-1}$ when the atmosphere of air was replaced by a mixture of H_2 and H_2O, and remained a relatively good conductor on cooling. Similar high conductivities were obtained for CdO in Cd vapour, although in neither case did the conductivity attain such a high value as the above empirical equation predicts for these low values of the oxygen partial vapour pressure. The nature of the variation with oxygen pressure indicates that the conductivity of both oxides is due to an excess of electrons. This is further confirmed by measurements of the thermal e.m.f. between rods of ZnO at different oxygen pressures. [See also preceding Abstracts.] R. W. P.

4214. Influence of Constitution of Cuprous Oxide on Electrical Properties. H. Dünwald and C. Wagner. *Zeits. f. phys. Chem.* 22. *Abt. B.* 3. *pp.* 212–225, *July,* **1933.**—Measurements of the electrical conductivity of Cu_2O have already been described [see Abstract 4511 (1932)]. It is now found that between 800° and 1000° C. the conductivity is approximately proportional to the 7th root of the oxygen pressure in the surrounding atmosphere. E.m.f. measurements support the conception of the conduction as being due to a deficiency in the number of electrons [see preceding Abstract]. The proportion of the conduction due to Cu ions is estimated at 4×10^{-4} at 1000° C. The dependence of excess O_2 in the Cu_2O on O_2 pressure and temperature is determined, and an estimation made of the temperature coefficient of electrical conductivity at constant O_2-content and pressure. R. W. P.

4215. Conductivity of Copper Oxide. H. H. v. Baumbach, H. Dünwald and C. Wagner. *Zeits. f. phys. Chem.* 22. *Abt. B.* 3. *pp.* 226–230, *July,* **1933.**—Values are given for the electrical conductivity of CuO up to 1000° C. It is found that the conductivity is practically independent of the oxygen partial pressure in the surrounding gas, and it would appear from this that the electronic excess is equivalent to the lattice deficiency [see preceding Abstract]. The theoretical significance of this conception is discussed. A supplement refers to recent determinations by le Blanc, Sachse and Schöpel [see Abstract 3761 (1933)], who state that the conductivity of powdered CuO at 400° C. is considerably greater in O_2 than in a vacuum. Additional measurements in atmospheres of pure O_2 and commercial N_2 reveal small differences, but they are not considered sufficient to modify the main conclusions of the paper. R. W. P.

4216. Compensation Method for Accurate Measurement of High Voltages. E. Hess. *Zeits. f. Physik,* 83. 9–10. *pp.* 698–700, *July* 6, 1933.—A static " null " method is described in which the voltage to be measured is applied to a guard-ring condenser connected to a quadrant electrometer. The electrical charge acquired by the electrometer is then compensated by means of a second guard-ring condenser of accurately

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adjustable capacity charged to a known potential. The method claims an accuracy of one part in a thousand. A. B. W.

4217. Use of Valve Electrometer with Extremely High Input Resistance. R. E. Burroughs and J. A. Ferguson. *Rev. Sci. Instruments*, 4. *p.* 406, *July*, 1933.—Calls attention to a difficulty in comparing the e.m.f.s of cells having very high resistances (of the order 10^{15} ohms). The electrometer input circuit may be considered as an e.m.f. charging a small capacity (the grid-filament capacity, say 3×10^{-12} farad) through a high resistance (that of the cell). After 100 seconds, the potential of the grid is found to be only 3·2 % of the applied potential. If the cell resistance is 10^{12} ohms, the grid potential is 94 % of the applied potential after 10 sec. The times involved in establishing steady conditions with very high cell resistances are so long that zero drift introduces serious errors. G. E. B.

4218. Voltmeter Amplifier. J. Roulleau. *Comptes Rendus*, 196. *pp.* 1786–1787, *June* 12, 1933.—In the amplification of a.c. currents and voltages for measurement, use is made of a 2-grid valve, of which the outer grid and plate are connected by an iron core transformer so as to give an audible frequency. The interior grid is connected to the source of e.m.f. to be measured, and so constitutes a kind of modulator. The modulated oscillations are amplified by a suitable amplifier and finally rectified, so that the magnitude of the impressed e.m.f. may be read on a milliammeter. Voltage differences of the order 10^{-5} volt may be measured, and an amplification of 2500 milliamperes per volt can be used. The use of the instrument is only restricted in that variations of the current must be slow compared with the frequency of the oscillator, and about 0·25 sec. must be allowed for steady conditions to be attained. G. E. B.

4219. High-Voltage Sensitivity D.C. Amplifier. P. A. Macdonald and E. M. Campbell. *Physics*, 4. *pp.* 237–240, *July*, 1933.—It is shown that a negative resistance of a definite value, introduced into the plate circuit of a thermionic valve theoretically allows the voltage sensitivity to become infinite. Practical application is made to construct high sensitivity d.c. amplifiers. The data show a mutual conductance of 30,000 μA per volt. AUTHORS.

4220. Evacuated Amplifying Device for the Measurement of Photoelectric Currents. J. F. H. Custers. *Zeits. f. techn. Physik*, 14. 4. *pp.* 154–157, 1933.—Describes a stable and sensitive amplifier for measuring photoelectric currents. The circuit is a two-valve bridge arrangement, employing Philips electrometer valves, Type 4060. The grid-filament resistance was at least 10^{15} ohms when the valve was clean and dry. The grid leaks, of resistance about 10^{10} ohms, were of a liquid-in-glass type, the liquid being alcohol with picric acid, benzol and phenol dissolved; these were found to be satisfactory from the point of view of constancy. The photo-cell was of the potassium type, with a little argon, and was provided with a quartz window. All the components of the amplifier were mounted in a glass vessel (provided with a quartz window), which could be evacuated. At a current sensitivity of $1 \cdot 35 \cdot 10^{-9}$ ampere per mm., the instability of the galvanometer only amounted to 0·25 mm., and the drift to only 1 cm. in 4 hours. The amplification factor was about 10^5 or 10^6. G. E. B.

4221. Resistance-Coupled Amplifier for Measuring Ionisation Currents. L. F. Curtiss. *Bureau of Standards, J. of Research*, 10. *pp.* 583–589, *May*, 1933.—A description is given of a simple two-stage

resistance-coupled valve amplifier for use in measuring ionisation currents down to the order of 10^{-13} ampere. Commercial dry-cell valves are used. It can be calibrated and will retain its calibration over considerable periods within 1 %. Where comparative measurements are required—for example, standardising radium preparations—it is capable of a much higher accuracy. Readings are made on a pointer-type microammeter. The stability of the circuit indicates that a more sensitive instrument could be used if more feeble currents are to be measured. A description is given of interchangeable ionisation chambers suitable for use with such an amplifier.
AUTHOR.

4222. Amplification of D.C. with a Tetrode. P. Donzelot and J. Divoux. *Comptes Rendus,* 196. *pp.* 1579–1581, *May* 22, 1933.—Fluctuations in the voltage of the grid bias and l.t. batteries can be eliminated by using a tetrode in conjunction with a potentiometer and a l.t. battery of large capacity. A suitable point on the valve characteristic must be chosen. Elimination of fluctuations in the plate potential can be achieved by using two tetrodes in a bridge circuit. J. E. R. C.

4223. Improved Balanced Circuit for Use with Electrometer Tubes. L. A. Turner and C. O. Siegelin. *Rev. Sci. Instruments,* 4. *pp.* 429–433, *Aug.,* 1933.—A modification of Soller's balanced circuit [see Abstract 5291 (1932)] for the use of a single FP-54 tube has been found which gives improved stability of balance and the possibility of use with galvanometers of high resistance. The theory of the circuit and detailed directions for calculating, setting up, and balancing it are given.
AUTHORS.

4224. Theory of the Skin Effect. E. Rothe. *Zeits. f. Physik,* 83. 3–4. *pp.* 184–186, *June* 14, 1933.—An abstract of a paper to be published in the *Journal für reine und angewandte Mathematik* on "The Integral Equation of the Skin Effect." A rigorous expression for the skin effect in any cylindrical conductor is deduced from Maxwell's equations.
J. E. R. C.

4225. Semi-Conductors: Dark Conduction and Photoelectric Conduction in Cuprous Oxide. E. Engelhard. *Ann. d. Physik,* 17. 5. *pp.* 501–542, *July,* 1933.—Investigation was made of the influence of incandescent treatment in oxygen and in a vacuum on the electrical conductivity and the Hall constant of Cu_2O in the range from room-temperature to –70° C. The results may be explained by the hypothesis that the electrical conduction is produced through excitation of an infra-red absorption band and the number and distribution of the absorption centres are influenced by tempering. The dependence on temperature of the Hall constant calculated from the photoelectric distribution of result agrees with that obtained from accurate measurements in the range from $+ 130°$ to $- 130°$ C. Further, it is deduced from measurements of the Hall effect on the photoelectric primary current that no difference exists between the mechanism of dark conduction and that of the photoelectric current. J. J. S.

4226. Supraconductivity and the Hall Effect. E. H. Hall. *Nat. Acad. Sci., Proc.* 19. *pp.* 619–623, *June,* 1933.—The experimental evidence from which Onnes inferred that the Hall effect does not exist in supraconducting metals is queried. It is suggested that the high conductivity of the supraconducting metal may prevent, or at least retard, the penetration of the magnetic flux within the material and so render the aforementioned tests inconclusive. According to the author's conception of a dual electric conduction a Hall effect would probably be expected to exist in supraconductors and to be of the same sign in all metals. It is also suggested that the persistent currents observed in supraconducting metallic rings may not be circumferential, as is assumed at present, but the aggregate effect of microscopic electric whirls within the metal. Experiments are suggested which should supply a definite answer to these two queries.

R. W. P.

4227. Relation between Electrolytic Conductivity and Self-Diffusion and Crystallographic Direction. W. Seith. *Zeits. f. Elektrochem.* 39. *pp.* 538–542; *Disc.*, 542, *July*, 1933.—The conductivity of PbI_2 is given by the equation $k = 9\cdot78 \times 10^{-4} \times e^{-4680/T} + 1\cdot15 \times 10^{-5} \times e^{-15000/T}$ [see Abstract 749 (1930)], the expressions on the right giving the partial conductivities due to (*a*) $Pb^{\cdot\cdot}$ and (*b*) I' respectively. Log *k*, 1/T curves have been determined along and perpendicular to the *c* axis of a single crystal of PbI_2. These are straight lines parallel to the corresponding lines given by (*a*) and (*b*) separately, and respectively above and below them, indicating heats of liberation of the ions of 28,500 and 8500–8800 cal./mol. Conductivity along the *c* axis is therefore predominantly due to $Pb^{\cdot\cdot}$, perpendicular thereto to I', which agrees with the lattice structure, and is consistent with the log (self-diffusion), 1/T curves of Pb in PbI_2 being independent of direction [see Abstract 1089 (1930)]. In bismuth these curves depend greatly on direction, that $\parallel$ to the *c*-axis corresponding to a heat of liberation of ions of 31,000, that $\perp$ thereto to one of 140,000 cal./mol. All measurements were made in both directions and no hysteresis was observed. [See also Abstract 441 (1933).]

C. A. S.

4228. Electrical Conductivity in Zeolites. E. Rabinowitsch and W. C. Wood. *Zeits. f. Elektrochem.* 39. *pp.* 562–566, *July*, 1933.—From observations of their behaviour it is considered that the conductivity of zeolites is a characteristic of the pure zeolite crystal. Current potential curves are given. The marked decrease of the resistance with rise of temperature indicates electrolytic conduction. Crystals of chabasite were examined. The resistance of this substance strongly increases with increasing loss of water. The conductivity is a reversible function of the water content. It is probable that the actual carriers of the current in zeolites as in most solid conductors are the most easily movable lattice ions, especially the alkali or alkaline earth kations. J. J. S.

4229. Limiting Conductivities of Salts in Non-Aqueous Solvents. C. W. Davies. *Chem. Soc., J. pp.* 645–648, *June*, 1933.—A method for calculating the limiting conductivities of salts from the Onsager-Debye-Hückel equations is developed. The method is applied to solutions of potassium iodide in benzonitrile, silver nitrate in benzonitrile, and the results show a fair agreement with accepted values. F. J. B.

4230. Anomalous Electrolytes. Part II. Electrical Conductivity of Iodine and of Iodine Compounds in Ketones. E. J. Birr. *Zeits. f. phys. Chem.* 165. *Abt.A.* 4–5. *pp.* 311–322. *July*, 1933.—Conductivity measurements are recorded for purified iodine, iodine cyanide and iodine trichloride, in carefully purified ketones (acetone, methyl ethyl ketone, acetophenone, cyclohexanone and benzophenone) at different concentrations and temperatures and with exclusion of light. The electrochemical, chemical, and physical properties of the various solutions make the following reactions probable between solvent and solute. In ketones, which are capable of an enol-rearrangement, there occur chemical exchanges with the solvent., *e.g.*, iodine by addition forms an iodohydrin which is a pseudo-electrolyte and which subsequently is transformed into a non-electrolyte. In cyclohexanone, an electrolytic dissociated addition compound is formed which is fairly permanent. In benzophenone the interaction between solvent and solute is probably limited to solvation of the dissociating iodine into a positive and negative ion. Iodine cyanide behaves similarly to iodine, but the processes in solutions of iodine trichloride are more complex. [For Part I see Abstract 2013 (1933).] H. H. Ho.

4231. Properties of Electrolytic Solutions. Part V. Conductance of Amido Salts in Liquid Ammonia. C. A. Kraus and W. W. Hawes. *Am. Chem. Soc., J.* 55. *pp.* 2776–2785, *July,* 1933.—Electrical conductivity has been measured of solutions in liquid ammonia, and dissociation constants calculated, of :—Sodiumphenyl-amine, $8 \cdot 2 \times 10^{-4}$; sodium-diphenyl-amine, 58×10^{-4}; sodium-triphenylboron amine, 150×10^{-4}; potassium-diphenyl-amine, $50 \cdot 5 \times 10^{-4}$; potassium triphenylboron amine, 130×10^{-4}. A. S. C. L.

4232. Conductivity of Hydrochloric Acid in Anhydrous Ether. T. Mounajed. *Comptes Rendus,* 197. *pp.* 44–45, *July* 3, 1933. The equivalent conductivity first decreases from 0·00588 ohm^{-1} for 0·02*N* to a minimum of 0·00053 for 1·10*N*, and then rises increasingly rapidly to 0·0629 for 5·5*N* and 0·4123 for 6·8*N*. This rise is possibly due to formation of complex combinations of hydrogen or chlorine ions with HCl. On standing the conductivity slowly increases, *e.g.*, to 0·0853 for 0·02*N* and 0·5947 for 5·5*N*, due to formation of ethyl chloride and water. C. A. S.

4233. Electrical Conductivity of Some Fused Salt Mixtures. E. Ryschkewitsch. *Zeits. f. Elektrochem.* 39. *pp.* 531–537 ; *Disc.,* 537, *July,* 1933.—The scanty literature of this subject is first briefly reviewed, following which comes a description of experiments respecting the conductivities of mixtures of fused alkaline and alkaline earth halides, mostly chlorides. In one case, fused soda was employed as a component, and conductivity data are also given for lithium chloride, lithium fluoride, and sodium cyanide. The components of the mixtures were so chosen that (1) their chemical natures were homogeneous, (2) they were completely miscible in the liquid melt, and (3) they formed no compounds with each other. The data indicate that the lithium fluoride melt is the best conductor of all electrolytes, and that its addition to salt melts will cause the greatest increase of conductivity. H. H. Ho.

4234. Sparks Produced by Short-Circuiting. W. Ende. *Ann. d. Physik,* 17. 4. *pp.* 460–462, *June,* 1933.—A sudden direct current is sent through a silver wire of 0·2 mm. dia. so that the wire disperses explosively into fine globules. This phenomenon is observed by means of a 30-ampere reflecting arc lamp and a slow motion camera as described earlier. Kleen had observed [see Abstract 1331 (1932)] that the liquefied wire broke up into a structure resembling a string of pearls. This was confirmed by the author, who succeeded in obtaining several thousand photographs per second which enabled the formation of the droplets to be followed in detail. H. L. B.

See also Abstracts 3884, 4126, 4152, 4239, 4244, 4286.

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DIELECTRICS AND CAPACITANCE.

4235. Capacity of a Long Wire. F. H. Murray. *J. Math. Phys.* 12. *pp.* 306–310, *May,* 1933.—Shows how, within an error of 1 %, the capacity may be computed by determining the average potential due to a constant charge distributed along the wire. A. D.

4236. Dielectric Polarisation of Liquid Phosphorus. S. Dobiński. *Zeits. f. Physik,* 83. 1–2. *pp.* 129–138, *June* 6, 1933.—Values of the dielectric constant and density of liquid phosphorus at a number of temperatures between 40° and 80° C. have been obtained. The influence of temperature on the value of the dielectric constant is considered ; it is found that there is a slight " kink " in the d.c./temp. curve at approximately 48·6°. If this irregularity is real, it indicates a transition point. Phosphorus has no dipole moment. W. R. A.

4237. Dependence of Dipole Moments on Solvents, and on the Infra-Red Terms and Binding Moments. O. Fuchs and H. L. Donle. *Zeits. f. phys. Chem.* 22. *Abt. B.* 1–2. *pp.* 1–20, *June,* 1933.—The principal sources of error in dipole moment measurements of dilute solutions are the solvent influence and the uncertainty of the infra-red terms. The magnitude of these errors is discussed, and new values for the electric moments of halogen derivatives of benzene and toluene have been calculated after computing the effect of the infra-red terms. The distribution of charge in the molecule and the question of binding moments are also considered. New measurements are recorded for acetone, acetophenone, benzophenone, *p*-chloracetophenone and *pp'*-dichlorobenzophenone. W. R. A.

4238. Composition of Electric Moments of Polyalcohols : Moments of Associated Dipoles. P. Girard and P. Abadie. *Comptes Rendus,* 197. *pp.* 146–148, *July* 10, 1933.—The statical dielectric constant ϵ_1 is proportional to the number of dipoles per unit volume c, the density d, and the polarisability of the molecule γ, *i.e.* $=Acd\gamma$, where A is a constant. $\gamma=\gamma'+\gamma''$, where γ' is the induced polarisability and is negligible compared with γ'', the permanent polarisability. $\gamma''=\mu^2/3kT$, where μ is the permanent moment of the dipoles, k Boltzmann's constant and T the absolute temperature. As ϵ_1 and d for the polyalcohols considered are practically constant if T is, $c\mu^2$ is so too ; or if μ_1 is the elementary moment due to one alcohol function ($=1\cdot 6\times 10^{-18}$ e.s.u.), $\mu=\mu_1\sqrt{n}$, n being the number of alcohol functions, which varies as c. These conclusions are verified by the following (the figures after each substance indicate respectively the values of ϵ_1 and the temperature for which that value has been determined) : glycol 37·6, 20° ; glycerol 40, 20° ; 32·5, 80° ; 26·6, 120° ; 22, 170° ; erythritol 28·2, 120° ; xylitol 40, 20° ; sorbitol 33·5, 80° ; mannitol 34·6, 170° ; glucoheptitol 27·4, 120° ; and glucoheptulitol 27·1, 120°. [See Abstract 3786 (1933).] C. A. S.

4239. Electrostatic Theory of the Frequency-Dependence of Ionic Mobilities and Dielectric Constants in Mixed Solutions of Strong Electrolytes. H. Falkenhagen and W. Fischer. *Zeits. f. Elektrochem.* 39. *pp.* 517–520, *July,* 1933.—In a previous paper [see Abstract 1179 (1933)], the general solution has been developed for the dispersion problem of the conductivity and the dielectric constants of mixtures of strong electrolytes on the basis of ionic clouds. The data of Bennewitz, Wagner and Küchler are now generalised for the stationary

case, which affords relatively simple expressions for the conductivity and changes of dielectric constant in application to the behaviour of mixed electrolytes in the h.f. field. By a like method the experimentally determined dispersion curves of Spaght are given their theoretical interpretation.
H. H. Ho.

4240. Thermal Instability in Cylindrical Condensers due to Dielectric Losses. B. L. Goodlet. *Cambridge Phil. Soc., Proc.* 29. *pp.* 401–404, *July* 30, 1933.—This investigation deals with the power losses when a dielectric is situated in an alternating field, and the expression $E < \left(\frac{2\lambda}{\gamma p_0}\right)^{\frac{1}{2}} \times \frac{e^{-\frac{1}{2}\gamma\theta_0}}{R}$ is derived for the maximum permissible stress, where R is the radius of a homogeneous cylinder extending to infinity in both directions so that the flow of heat is purely radial, θ is the temperature at any point r, E is the electric intensity uniform over the disc, $p=f\,(E, \theta)$ is the dielectric loss per unit volume at r, and λ is the thermal conductivity of the material. When the radius of the condenser is small, this expression gives values of breakdown intensity far in excess of those actually observed, a result explained by the fact that a dielectric has a number of different breakdown intensities. Only the lowest of these can be experimentally observed and the above expression gives the actual breakdown voltage only in the range of thermal breakdown. H. H. Ho.

See also Abstract 3951.

ELECTROCHEMISTRY.

4241. Electrolysis of Copper Salts of Organic Acids. G. Kravtzoff. *Comptes Rendus,* 197. *pp.* 137–140, *July* 10, 1933.—The copper deposited on electrolysis of copper salts of formic, acetic, propionic, chloro- and trichloro-acetic, and benzenesulphonic acids, the concentration varying from 3·65 to 41·5 g./l. of Cu, and the current density from 0·2 to 0·8 A/dm^2., forms brittle deposits of colour varying from the normal to blue-black (acetate) and green (trichloroacetate). With the propionate, chloro- or trichloro-acetate the deposits form striæ, which follow the lines of force. The ratio of weight of deposit : weight in a coulobmeter is usually >1 (1·47–0·96), it diminishes with increase in current density, acidity, dilution, or agitation. X-ray examination indicates the presence of Cu_2O in the deposit. [See Abstract 428 (1933).] C. A. S.

4242. Electrolytes in Mixed Solvents. Part V. Free Energy of Lithium Chloride in Water-Alcohol Mixtures and Salting-Out of Alcohol. J. A. V. Butler and D. W. Thomson. *Roy. Soc., Proc.* 141. *pp.* 85–94, *July* 3, 1933.—The measurements of Shaw and Butler of the partial pressures of water and ethyl alcohol in solutions containing lithium chloride have been extended to solutions containing 2 and 4 mol. per cent of ethyl alcohol. A discussion is given of the thermodynamics of salting out. It is pointed out that the salting out is properly measured, not by the change of the activity of the non-electrolyte produced by the salt, but by the difference between this quantity and the normal effect, which is defined. The partial free energies of transfer of lithium chloride from water to alcoholic solutions have been calculated from the partial pressures of water and alcohol. The variation is approximately linear with the molar fraction of alcohol. [For Part IV see Abstract 742 (1933).]
AUTHORS.

4243. Ionic Activity at Extremely High Concentrations. F. Tödt. *Zeits. f. Elektrochem.* 39. *pp.* 521–526, *July*, 1933.—This very comprehensive paper contains a review of the ionic activities of hydrogen measured under many different conditions, and a discussion of the various theories put forward to account for the results obtained by the numerous investigators in this field. H. H. Ho.

4244. Thermodynamic Ionisation Constants of Carbonic Acid. D. A. MacInnes and D. Belcher. *Am. Chem. Soc., J.* 55, *pp.* 2630–2646, *July*, 1933.—The first and second dissociation constants of carbonic acid have been determined at 25° by an apparatus with glass electrodes and cells without liquid junctions. The values obtained are $4 \cdot 54 \times 10^{-7}$ and $5 \cdot 61 \times 10^{-11}$. These are claimed to be more accurate than previous values. A. S. C. L.

4245. Boundary Layer of Dilute Electrolytes. M. Planck. *Preuss. Akad. Wiss. Berlin, Ber.* 7. *pp.* 362–368, 1933.—This paper continues previous publications [see Abstract 3660 (1931)], and investigates mathematically the condition of the boundary layer. It is found unexpectedly, that the p.d. between two electrolytes increases initially with the time, and that dE/dt is proportional to the square of the thickness and independent of the sign of the concentration difference. This indicates that the direction in which the potential difference changes at the beginning of the diffusion has nothing to do with the difference of potential in the mixture state and in the stationary state of the boundary layer. An explanation is suggested for these phenomena. H. H. Ho.

4246. P.D. between Copper and its Amalgam, and Reproducibility of the Copper Electrode. M. Oku. *Tohoku Univ., Sci. Reports,* 22. *pp.* 288–300, *May*, 1933. *In English.*—The preparation of a standard copper electrode has hitherto been an unsolved problem. The method of preparation is here described. The p.d. between this electrode and a heterogeneous copper amalgam has been determined very accurately by measuring the e.m.f. at various temperatures of the cell, $Cu|CuSO_4(0 \cdot 1 \text{ or } 0 \cdot 05M)|Cu(Hg)$. AUTHOR.

4247. Mechanism of Action of Light on Electrodes Photosensitised by Copper Salts. R. Audubert. *Comptes Rendus,* 196. *pp.* 1588–1590, *May* 22, 1933.—Measurements of the photopotential of electrodes of copper coated with Cu_2O, CuO, CuI, or CuCl in aqueous cupric sulphate of varying concentration, and in solutions, buffered with sodium phosphate and citrate, of varying pH give results in agreement with the theory that a positive photovoltaic potential is connected with oxidation, and negative with reduction, *i.e.*, that the photovoltaic behaviour of such electrodes is due to the photolysis of water. [See Abstracts 2643 (1932) and 3196 (1933).] C. A. S.

4248. Mechanism of Hydrogen Overvoltage and the Electrolytic Oxidation of Hydrogen. L. P. Hammett. *Faraday Soc., Trans.* 29. *pp.* 770–775, *July*, 1933.—An equation for the rate in the forward and in the reverse directions of the reaction $2H^{+}2e \rightleftarrows H_2$ was derived on the assumption that the two reactions $H^{+} + e \rightleftarrows H$, and $2H \rightleftarrows H_2$ are of comparable importance in determining the velocity of the total reaction. The equation was confirmed very closely by current potential curves determined on platinum electrodes. F. J. B.

4249. Cryoscopic Determination of Hydration of Ions of Ammonium Chloride. F. Bourion and E. Rouyer. *Comptes Rendus,* 197. *pp.* 52–54, *July* 3, 1933.—The hydration of the ions in M and $M/2$ NH_4Cl is represented respectively by NH_4Cl, $6 \cdot 2H_2O$ and NH_4Cl, $7 \cdot 5H_2O$. [See also Abstract 3200 (1933).] C. A. S.

See also Abstracts 3884, 3887, 3951, 3955, 4059, 4173, 4174, 4239.

ELECTRONS AND PROTONS.

4250. Most Probable Values of *e, e/m* and *h*. K. Shiba. *Inst. Phys. and Chem. Research, Tokyo. Sci. Papers, No.* 434. *pp.* 128–137, *July,* 1933. *In English.*—The determination of the most probable values of e, e/m and h, given in a previous paper [see Abstract 378 (1933)], is here modified by the omission of the rather doubtful and relatively inaccurate values of the Stefan-Boltzmann and Wien-Planck constants and by the introduction of the following new data: (*a*) absolute measurement of X-ray wave-length by Witmer and Cork, (*b*) determination of e/m by a deflection method (Dunnington), (*c*) experiments with photoelectrons by Kretschmar. The most probable values finally obtained are: $e = (4 \cdot 804 \pm 0 \cdot 003) \times 10^{-10}$ e.s.u.; $e/m = (1 \cdot 760\,2 \pm 0 \cdot 0005) \times 10^7$ c.g.s. e.m.u.; $h = (6 \cdot 626 \pm 0 \cdot 006) \times 10^{-27}$ erg. sec.; $\frac{hc}{2\pi e^2} = 136 \cdot 94 \pm 0 \cdot 5\ \%$ (Eddington's theoretical value = 137). W. S. S.

4251. Determinations of the Charge on Small Test Particles. A. Lustig and M. Reiss. *Zeits. f. Physik,* 84. 1–2. *pp.* 131–135, *July* 17, 1933.—A further contribution to the controversy as to the existence of sub-electronic charges bearing particularly on recent work by the authors and by Nestle and Schäfer [see Abstract 3202 (1933)]. W. S. S.

4252. Intensity of Scattered Radiation due to Moving Free Electrons. W. Pauli. *Helv. Phys. Acta,* 6. 4. *pp.* 279–286, 1933. *In German.*—The Klein-Nishina formula determines the intensity of scattered radiation by electrons which are initially free. The problem here treated is whether bound electrons scatter in accordance with the formula as soon as the incident radiation has a frequency which is great compared with the ionising frequency of the atom. By considering various limiting cases the author shows that this formula does not apply in these circumstance, but that there is a sort of Doppler effect of the intensity of scattered radiation. The Lorentz transformation of the Klein-Nishina formula is obtained generally. H. L. B.

4253. Intensity of Scattered Radiation of Bound Electrons. H. Casimir. *Helv. Phys. Acta,* 6. 4. *pp.* 287–304, 1933. *In German.*—Pauli has shown [see preceding Abstract] that it is wrong to assume that the scattering power of bound and free electrons becomes asymptotically equal in the limiting case where the energies of the incident and the scattered quantum and also the difference of their energies (*i.e.*, the energy transferred to the electron) becomes great compared with mc^2. The scattering power depends on the initial velocity of the electron and this may not simply be set equal to zero in the case of a bound electron. The author here considers the scattering by K-electrons and by making certain assumptions obtains results which may plausibly be regarded as correct. H. L. B.

4254. Scattering of Electrons by Atoms. J. Winter. *Comptes Rendus*, 196. *pp.* 1299–1301, *May* 1, 1933.—A mathematical study of the effect of a sphere of potential, in which the potential has spherical symmetry, on the propagation of a train of plane de Broglie waves (stream of incident electrons). The potential sphere gives rise to an isotropic divergent flux and a fine pencil of flux in the opposite direction to the incident flux and of intensity equal to that of the divergent flux. W. S. S.

4255. Electron Scattering by Heavy Atoms. W. Henneberg. *Zeits. f. Physik*, 83. 9–10. *pp.* 555–580, *July* 6, 1933.—The angular distribution of elastically scattered electrons is calculated using the Fermi atom and the Wentzel-Kramers-Brillouin method of calculating the eigenfunction of the scattered electrons. The formula admits of extending the results obtained for one atom to any other atom. The calculated scattering of 100–800 volt electrons by mercury, krypton and argon is compared with experimental data, the calculated and observed maxima and minima agreeing fairly well as to position. The scattering of fast electrons (30 kV) by mercury is calculated and shown to deviate considerably from that predicted by Born's theory. J. E. R. C.

4256. Scattering of Electrons by Metal Vapours. Part I. Cadmium. E. C. Childs and H. S. W. Massey. *Roy. Soc., Proc.* 141. *pp.* 473–483, *Aug.* 1, 1933.—The angular distributions of slow electrons scattered from cadmium vapour have been investigated over the angular range from 25° to 130°. Scattering curves have been obtained for 4, 8, 13, 18, 23, 28, 38, and 48 volt electrons. These curves exhibit maxima and minima closely resembling those appearing in corresponding curves for mercury vapour. The significance of these results is discussed, and their bearing on the possible application of scattering measurements to the determination of atomic and molecular fields is considered. AUTHORS.

4257. Electron Diffraction and Photoelectric Action of Alkali Metal Surfaces. W. Kluge and E. Rupp. *Zeits. f. Physik*, 82. 9–10. *pp.* 568–583, *May* 23, 1933.—Continuing previous work [see Abstract 4568 (1932)], results are given concerning the reproducibility of the observed electron reflection maxima. For a given angle the voltages at which these maxima occur are shown to remain unchanged when the temperature is lowered from room temperature to −170°C. In agreement with the results of other workers a reversible temperature dependence is found for the photoelectric effect. Attention is drawn to two as yet unexplained phenomena associated with the electron reflection experiments. The first is the fact that the curve of reflection against voltage is sometimes different according as to whether the procedure in determining it is to increase or to decrease the voltage. Secondly, there is in rare cases a sudden discontinuity of the curve at a certain voltage. Impurities are shown to render the photoelectric effect more selective, but to repress or remove the electron interference maxima. Most of the maxima can be ascribed to reflection at the planes 100, 110 and 111, assuming integral orders and unit refractive index. L. A. W.

4258. Electron Diffraction by Liquids. L. R. Maxwell. *Phys. Rev.* 44. *pp.* 73–76, *July* 15, 1933.—Electron interference has been obtained by the transmission of electrons (14 to 30 kV) through thin liquid films of phytol ($C_{20}H_{39}OH$), Nujol and two different grades of Cenco vacuum pump oil. The patterns obtained for these four liquids are all practically the same and are characterised by three complete diffraction rings. The values of $(1/\lambda) \sin \theta/2$ for phytol were found to be 0·108, 0·236 and 0·420. These rings could be produced by diffracting planes of spacings 4·63, 2·1 and 1·2 Å. These distances are practically identical with the values obtained by G. W. Stewart for X-ray diffraction in liquid pentadecane ($C_{15}H_{32}$) and tetradecane ($C_{14}H_{30}$). The problem of interpreting the results by a group theory such as proposed by Stewart is the same for electrons as for X-rays. AUTHOR.

4259. Electron Diffraction and Molecular Structure. R. W. Dornte. *J. Chem. Phys.* 1. *pp.* 566–571, *Aug.*, 1933.—The molecular tructures of cis- and trans- dibromoethylene, tribromoethylene, vinyl sbromide, tetrachloroethylene and trichloroethylene have been determined by the method of electron diffraction in gases. It has been found that the diffraction pictures of these substances can be satisfactorily represented by plane structures having the following interatomic distances: $C = C$ 1·3, $C - Br$ 2·0 and $C - Cl$ 1·8 Å. The diffraction in CCl_4 has been investigated with several widely differing electron velocities. AUTHOR.

See also Abstracts 3895, 3896, 3898, 3927, 3932, 3938, 4041, 4075.

ELECTROSTATICS.

4260. Influence of Field Strength and of the Time the Gases are in Electro-Filters upon the Degree of Purification. S. Kalaschnikow. *Zeits. f. techn. Physik*, 14. 7. *pp.* 267–270, 1933.—The influence of field strength, axial velocity of gases and electro-filter dimensions has been investigated with respect to the separation of four different kinds of particles. Complete agreement was found with the Deutsch exponential law [see Abstract 2778 (1931)] and with the theory of the charging of particles. It is concluded, in harmony with the opinions of Deutsch, Mierdel and Seeliger, that any other assumptions for the explanation of the chief processes which actually occur in electro-filters are superfluous. H. H. Ho.

See also Abstracts 4038, 4223, 4239.

GALVANOMAGNETIC AND THERMOMAGNETIC EFFECTS.

4261. Influence of Barkhausen Magnetisation Jumps on the Electrical Conductivity. D. S. Steinberg and F. Miroschnitschenko. *Phys. Zeits. d. Sowjetunion*, 3. 6. *pp.* 602–605, 1933. *In German.*—Of the two methods of magnetisation, (*a*) by slow rotation of the magnetising vector, and (*b*) by momentary change of direction of the vector by 180°, only the first has any effect on the electrical conductivity, the second having no effect at all. In so far as the Barkhausen magnetisation jumps can be represented as sudden changes of direction of the magnetisation vector through 180°, they have no effect on the electrical conductivity. A. W.

See also Abstract 4226.

MAGNETISM AND ELECTROMAGNETISM.

4262. Integration of the Maxwell-Hertz Equations in Uniaxial Crystalline Media. A. Tonolo. *Accad. Lincei, Atti*, 17. *pp.* 806–809, *May* 21, 1933.—A continuation of a previous paper [see Abstract 3837 (1933)] on a solution of the electromagnetic equations in a uniaxial crystalline medium. A. J. McC.

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4263. Poynting's Vector. F. Prunier. *Comptes Rendus*, 197. *pp.* 131–132, *July* 10, 1933.—A mathematical note in which a new expression for Poynting's vector is given. J. J. S.

4264. Magnetised Spheroid Immersed in a Permeable Medium. L. Page. *Phys. Rev.* 44. *pp.* 112–115, *July* 15, 1933.—The effect of immersing a permanently magnetised spheroid with a uniform intensity of magnetisation parallel to its axis of symmetry in a magnetic medium of constant permeability μ is investigated. If γ is the ratio of the field-strength H in the absence of the medium to that in the presence of the medium, it is found that γ changes from 1 for a disc to $(2\mu + 1)/3$ for a sphere and then to μ for a needle. This is contrary to the generally accepted statement that $\gamma = \mu$ for a magnet of any shape. [See also Abstract 1639 (1933).] AUTHOR.

4265. Theory of the Exchange Problem and of Ferromagnetism at Low Temperatures. C. Møller. *Zeits. f. Physik*, 82. 9–10. *pp.* 559–567, *May* 23, 1933.—Bloch's treatment of Slater's secular equation for a system of atoms each with one valency electron by the introduction of a " Hamiltonian function of the exchange problem " is shown to be capable of generalisation so as to cover the case of any number of valency electrons per atom. Indeed the expression for the Hamiltonian function remains unchanged, so that the general problem can be treated just as easily as the special case. As an application an investigation is given of the ferromagnetism of a simple cubic crystal with z valency electrons per atom at low temperatures. L. A. W.

4266. Heusler Alloys. S. Valentiner and G. Becker. *Zeits. f. Physik*, 83. 5–6. *pp.* 371–403, *June* 20, 1933.—It is shown that the magnetic properties of Heusler alloys depend on the presence of the crystal $MnAlCu_2$. This body acts as a ferromagnetic element with at least 20 Weiss magnetons and a Curie point about 330° C. Magnetic alloys of Mn, Al and Cu contain this crystal in greater or smaller amount, and a strong magnetic alloy is is produced from 25 % Mn, 25 %Al and 50 % Cu. This alloy has a body-centred lattice with length of edge 5·950 Å, both after quenching from 800° and also after ageing at temperatures below 350°. At temperatures between 350° and 700° the crystal forms $AlCu_3$ and $MnAlCu_2$ with included atoms of Mn appear, and the material is not so magnetic as $MnAlCu_2$. The saturation value of alloys of other compositions depends on the amount of Mn present in the $MnAlCu_2$ crystals, and this again is determined by the relative proportions of the constituents, the temperature, and the heat treatment. The coercive force increases in general at first with ageing, then decreases, because during ageing lattice changes set up stresses which with progressive change of lattice become less. The Curie point is little affected by the composition of the alloy. The effects of excess of Mn and of Al are described. A remarkable feature is the very high coercive force at low saturation for alloys with composition not varying much from $MnAlCu_2$. For example : H_c is 900 for an alloy containing 25 % Mn, 30 % Al and 45 % Cu. G. E. A.

4267. Magnetisation of Iron by Superposing an Alternating Field on a Constant Field. S. Procopiu. *Comptes Rendus*, 196. *pp.* 1976–1979, *June* 26, 1933.—When to a constant field H_0 is added an alternating one h which increases in amplitude from zero, the initial magnetisation I_0 increases with h, reaches a maximum I_m when h is equal to the coercive force H_c, and thereafter decreases rapidly. The author finds an expression for the magnetisation I as dependent on *h*, *viz.*,

$$I = I_m e^{-\frac{\pi}{4}\left(\frac{h-H_c}{H_c}\right)^2},$$

and also an expression for the susceptibility according to the curve of ideal magnetisation. G. E. A.

4268. Magnetic Hysteresis Created by Alternating-Current Magnetisation. Edel-Agatha Neumann. *Zeits. f. Physik,* 83. 9–10. *pp.* 619–631, *July* 6, 1933.—The paper discusses the existence of an " after effect " in the hysteresis loop at high maximum induction (12 to 16 kilogauss) caused by alternating current magnetisation of the region about 50 hertz. The loop obtained by calculation from the influence of eddy currents, etc., is compared with the static curve measured ballistically. In unalloyed iron the effect creates a broadening of the hysteresis loop whilst a 4 % iron-silicon alloy exhibits no measurable effect. S. G. B.

4269. Absolute Saturation of Cubic Cobalt. R. I. Allen and F. W. Constant. *Phys. Rev.* 44. *pp.* 228–233, *Aug.* 1, 1933.—With an ellipsoid of cobalt, quenched so as to be in the cubic state, and Weiss' method of extracting the ellipsoid from the field of a powerful electromagnet, the magnetisation was measured for a given temperature but increasing field-strengths. With Weiss' formula for the approach to saturation the magnetisation for infinite field was calculated. The Weiss' formula fitted the upper half of the experimental curve within 0·03 %. When the saturation magnetisations, J_{ST}, obtained for 13 temperatures were plotted against the square of the absolute temperature a straight line was obtained. When this was extrapolated to absolute zero the saturation intensity (J_{SO}) was found to be 1418. By plotting J_{ST}/J_{SO} against $T/\theta)^2$, θ being the Curie point, the line obtained coincided with that for iron and nickel, but not with the curve for hexagonal cobalt nor the line found for orthorhombic crystals. It is indicated that crystal structure plays an important part in ferromagnetism. AUTHORS.

4270. Extremely Low Temperatures by Adiabatic Demagnetisation of Salt of Rare Earth. W. J. de Haas, E. C. Wiersma and H. A. Kramers. *Comptes Rendus,* 196. *pp.* 1975–1976, *June* 26, 1933.—A small tube containing CeF_3 was suspended in an evacuated enclosure immersed in liquid helium at 1·26° K. A magnetic field of 30 kilogauss was suddenly reduced to 2·5 kilogauss, and the magnetic moment of the salt was measured with respect to time. On extrapolating the susceptibility beyond the region for liquid helium (4° to 1·3° K.) the temperature found was below 0·27° K. Other measurements gave a value below 0·18° K. The lowest temperatures reached by reducing the saturation pressure of liquid helium were 0·82° K. (Onnes) and 0·71° K. (Keesom). **A. Cotton** remarks that the above observations give experimental proof of the change of temperature which Langevin's theory (1905) requires as the result of a change of magnetisation in paramagnetic bodies. **A. d'Arsonval** recalls that he suggested the use of the Peltier effect in 1902 to obtain a lowering of temperature, and that Turrettini had applied it in 1929 and had obtained temperature falls of 18°. G. E. A.

4271. Magnetic Susceptibilities of Salts of the Iron Group by a Modification of Quincke's Method. H. Breternitz. *Phys. Zeits.* 34. *pp.* 507–516, *July* 1, 1933.—Quincke's method has been modified so that a suspension method can be used. Measurements have been made on aqueous solutions of manganese sulphate, ferrous sulphate, and ferric sulphate and chloride at different concentrations and at field-strengths throughout the interval 100–600 gauss. The dependence of the susceptibilities on field strength and on concentration is discussed. It was found that the susceptibility of all solutions was greatest at intermediate concentration. W. R. A.

4272. Mutual Inductance of any Two Coaxial Single-Layer Coils. F. W. Grover. *I.R.E., Proc.* 21. *pp.* 1039–1049, *July*, 1933.—Absolute formulæ for the calculation of the mutual inductance of coaxial solenoids, although they are required for work of the great precision necessary in absolute measurements, are not convenient for routine calculations. Series formulæ, although simpler, are limited in the range of their convergence, thus requiring the choice of the proper formula for any given problem. The tables and formulæ here presented enable the mutual conductance of any two coaxial solenoids whatever to be calculated from a single formula. Examples make clear that a five-figure accuracy may be attained with concentric coils and even with poorly coupled coils the error does not exceed a few parts in ten thousand. AUTHOR.

4273. Magnetostriction of Nickel-Cobalt Alloys. Y. Masiyama. *Tohoku Univ., Sci. Reports*, 22. *pp.* 338–352, *May*, 1933. *In English.*—Continuing previous work [see Abstract 781 (1933)] the magnetostriction of Ni-Co alloys was investigated. The longitudinal effect is just the reverse of the transverse effect, and the volume change is a differential effect of these two. In these cases a marked discontinuous change in the effect-concentration curve takes place at about 75 % cobalt, this concentration corresponding to the change from a face-centred cubic lattice to a hexagonal close-packed one. AUTHOR.

See also Abstracts 3945, 4074, 4261.

MEDICAL RADIOLOGY AND ELECTROLOGY.

4274. New Fluorescent Screen for Visual Examinations. L. Levy and D. W. West. *Brit. J. of Radiology*, 6. *pp.* 404–410, *July*, 1933.—The requirements of a fluorescent screen for visual X-ray examinations are discussed from the points of view of brightness, definition, afterglow, response to hard radiations, contrast and colour, and durability. Most screens used up to the present have employed barium platinocyanide, zinc silicate or cadmium tungstate as the active substance. A new screen is described which utilises a form of zinc-cadmium sulphide. Curves are given showing the variation of brightness of this screen and the standard cadmium tungstate screen with kilovoltage and milliamperes in the X-ray tube. In general the new screen gives approximately twice the illumination obtained from the cadmium tungstate screen. The other properties of the screens are compared and the zinc-cadmium screen is shown to be superior in almost every respect. J. E. R.

4275. Fundamental Units and Terms for Biologically-Effective Radiation. M. Luckiesh and L. L. Holladay. *J.O.S.A.* 23. *pp.* 197–205, *June*, 1933.—A system of proposed erythemal units, terms and magnitudes is developed, and instances of the practical application of the system are given. W. E. P.

4276. Biological Response to γ-Rays of Radium as a Function of the Intensity of Radiation. F. G. Spear and L. G. Grimmett. *Brit. J. of Radiology,* 6. *pp.* 387–402; *Disc.,* 402–403, *July,* 1933.—In a series of preliminary experiments in which the effect of radiation on the cell division in tissue cultures was investigated, it was observed that the dose required to give a certain percentage fall in mitosis depended on the absolute intensity of the radiation. The experiments described consist of a careful and accurate investigation of this problem. An account is given of the technique of preparation of the cultures and of obtaining consistent mitotic counts. The radiation source consisted of 3·6 gm. of radium packed in 18 tubes arranged in a circle; the intensity of radiation was varied by changing the distance between the radium and the culture. Tables and curves are given showing the effect on the percentage mitotic survival of different times of irradiation at six different intensities. From these results a series of curves are drawn showing the variation with intensity of the dose required to produce given values of the percentage survival (35 %, 40 %...80 %). In every case it is seen that in passing from lower to higher intensities the dose required to produce a given survival decreases steadily to a minimum value in the neighbourhood of an intensity $I = 62$ Sievert units [probably about 9·3 R/min.], and then begins to increase. Beyond about 120 units the dose required to produce any given biological effect appears to remain constant. Theoretical considerations are discussed, and it appears that the observed differences in biological activity are due to variations in radiation intensity alone. In the *Discussion,* **W. V. Mayneord** pointed out that the method of varying intensity by changing distance might involve very considerable changes in filtration.

J. E. R.

4277. Electrocardiograph Incorporating a Valve Amplifier and a Thompson-Type Industrial Oscillograph. J. Priore. *J. de Radiologie et d'Électrologie,* 17. *pp.* 330–333, *June,* 1933.—A short description is given of an electrocardiograph in which the electrical oscillations are amplified by means of a valve amplifier and recorded with the aid of a simple electromagnetic oscillograph. The amplifier consists of a modified form of one described previously by Fabre (*J. de Radiologie,* 1930). In the grid circuit of the output valve a rheostat is introduced so that the recorded trace can be adjusted to a standard value of 1 cm. corresponding to 1 millivolt. To avoid the recording of extraneous oscillations of high frequency a reduced model of the Thompson electromagnetic oscillograph is used. A brief description of the use of the instrument in practice is given.

J. E. R.

4278. Ultra-Violet Rays in Industry. M. J. Dorcas. *Am. Illum. Eng. Soc., Trans.* 28. *pp.* 575–589, *July,* 1933.—A comprehensive summary is presented of some of the unusual and interesting applications of ultra-violet radiation in industrial processes, with descriptions of the methods used and the results obtained. Similar data are given of applications in agriculture, the sterilisation of foods, the production of vitamin D, and the use of so-called "black light" in the detection of spoilage in manufactured products, and a number of other special applications.

AUTHOR.

OSCILLATIONS.

See Abstract 3957.

PHOTOELECTRICITY.

4279. Theory of Complex Photoelectric Effects. L. Goldstein. *Comptes Rendus*, 197. *pp.* 304–306, *July* 24, 1933.—From quantum theory it is shown that a photon incident upon and absorbed by an atom containing many electrons can liberate therefrom, by elementary action, more than one electron. J. S. G. T.

4280. Inner Photoelectric Effect in Metals. R. Schulze. *Phys. Zeits.* 34. *pp.* 381–385, *May* 1, 1933.—The outer photoelectric effect has been hitherto observed almost exclusively in metals, and the inner in highly insulating crystals. The effect recently discovered by Majorana [see Abstract 2088 (1933)] can hardly be described as photoelectric, as it involves an increase of resistance under illumination. Experiments were conducted with very thin films of gold and magnesium. The angle of incidence of the light was varied, and it was found that in every case the electrons liberated travelled in the direction of the light. E. E. F. d'A.

4281. Interior Photoelectric Effect in Cuprous Oxide. D. Nasledow and L. Nemenow. *Zeits. f. Physik*, 81. 9–10. *pp.* 584–604, *April* 7, 1933.—In cuprous oxide of ordinary conductivity increase of conductivity under illumination must in all cases be attributed mainly to heat, even when the experiments are conducted in liquid air. The photoelectric conversion of the quantum cannot exceed $5 \cdot 10^{-47}$ of an electron per quantum. In cuprous oxide of high resistance (10^7 ohm. cm.) a 600-fold increase of conductivity was observed, and this can only be due to an internal photoelectric effect. E. E. F. d'A.

4282. Non-Additive Effect of Different Radiations on Copper Oxide Photoelectric Elements. C. Lapicque. *Comptes Rendus*, 196. *pp.* 1301–1303, *May* 1, 1933.—The current given by a copper oxide photoelectric element when exposed to radiation throughout the whole spectrum is not calculable by integrating the product of the energy density of the radiation and the spectral sensitivity determined with monochromatic light. Radiation of wave-length greater than $0 \cdot 65\mu$, which by itself produces a photoelectric current i_1, and radiation between $0 \cdot 45\mu$ and $0 \cdot 65\mu$, which by itself produces a current i_2, when applied together, give a current greater than $i_1 + i_2$. Particulars of this phenomenon are described. W. S. S.

4283. Photoelectric Effect for Single Crystals of Cuprite. R. Deaglio. *Comptes Rendus*, 196. *pp.* 1303–1305, *May* 1, 1933. *Zeits. f. Physik*, 83. 3–4. *pp.* 179–183, *June* 14, 1933.—Experiments are described to show that the so-called Dember effect, in which a crystal of cuprite gilded on opposite sides and put in series with a galvanometer gives a current when illuminated, arises from the property of cuprite of acquiring an electrolytic conductivity when acted upon by light. By driving a current through (*a*) a cuprite cell continuously illuminated, and (*b*) a cuprite cell kept in the dark it was found that the photoelectric effect given by the former was reduced to one-tenth in six days, that of the latter showing no diminution in a like period of time. W. S. S.

4284. Internal Photoelectric Absorption in Halide Crystals. R. W. Gurney. *Roy. Soc., Proc.* 141. *pp.* 209–215, *July* 3, 1933.—In the quantum mechanical model of an insulating crystal there are bands of electron levels separated by wide zones of disallowed energies. In a perfect lattice these zones are empty and the occupied levels are not localised. Throughout an imperfect crystal are distributed numerous submicroscopic cracks, on the surfaces of which will be localised levels with energies lying in the empty zones. The formation of a latent image consists in the transfer of electrons to these localised energy levels in the disallowed zones.

AUTHOR.

4285. Photoelectric Effect of Crystals of Argentite, Proustite, and Pyrargyrite. G. Athanasiu. *Comptes Rendus*, 197. *pp.* 42–44, *July* 3, 1933.—On inserting a crystal of argentite in a circuit and illuminating its contact with one electrode a negative e.m.f. (*i.e.* electrons passing from crystal to illuminated electrode) is observed in light of $\lambda 0\cdot5$–$1\cdot4\mu$, maximum for $1\cdot15\mu$; an auxiliary current of a few mV, if negative, increases, if positive, annuls and then reverses the photovoltaic current. Proustite and pyrargyrite with a Pt electrode give a positive current, maximum for $0\cdot58$ and $< 0\cdot45\mu$, and $0\cdot62$–$0\cdot65$ and $< 0\cdot45\mu$, respectively, but sometimes negative with a Cu electrode and red light; in both cases the maxima are for wave-lengths for which a region of strong absorption begins. An auxiliary current of $0\cdot6$ volt is required to reverse the effect. Some crystals of pyrargyrite with darker surface show no maximum but only a steadily decreasing sensitiveness from $0\cdot45$ to $0\cdot80\mu$. In all cases the wave-lengths of the light giving maximum effect are those giving maximum conductivity at low temperatures (-110 to $-136°$). [See also Abstract 1384 (1928).]

C. A. S.

4286. Equivalent Circuit of a Blocking-Layer Photo-Cell. L. A. Wood. *Rev. Sci. Instruments*, 4. *pp.* 434–439, *Aug.*, 1933.—A general method of determining the equivalent circuit elements of a network containing any number and arrangement of resistances with one variable impedance element involves plotting a graph of the reactive component of the impedance against the resistive component at different frequencies. Capacitance bridge measurements at audio-frequencies with a Weston Photronic cell at different illuminations yield data for such a graph. Circles are obtained from which it is concluded that the impedance element itself is capacitative and maintains a constant phase difference of the order of magnitude of 10° between current and voltage. The impedance of the cell as a whole decreases radically with frequency. From the circles it is found that the equivalent resistance in series with the impedance element is of the order of 35 ohms and is independent of illumination and other variable factors. The equivalent resistance in parallel with the impedance element is of the order of several thousand ohms, decreases with illumination and varies from day to day. After illumination, more than 10 min. elapse before steady conditions are again attained in the dark. The impedance element itself is regarded as capacitance of the order of $0\cdot5\mu$F and a series resistance, each decreasing with frequency. The capacitance varies approximately inversely as the frequency raised to the $0\cdot1$ power, and the resistance inversely as the frequency raised to the $0\cdot9$ power. Fricke's equation relating the former exponent to the phase difference is found applicable. The capacitance increases and the resistance decreases with illumination. A general similarity to electrolytic polarisation capacitance is noted. When an inductance coil is placed across the cell and the cell is illuminated with light of sinusoidally-varying intensity, resonance is obtained at a definite critical frequency.

AUTHOR.

4287. Noises in Amplifiers of Photoelectric Cells. Part II. Experimental Results. F. v. Orbán. *Zeits. f. techn. Physik.* 14. 4. *pp.* 137–143, 1933.—The fluctuations ("noises") in photoelectric cell amplifiers

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involve two effects; the shot effect of the photoelectric cell and the thermal agitation in the first grid circuit. With vacuum cells at saturation the shot effect is proportional to the photoelectric current. In contrast to the case of thermionic tubes it also maintains its theoretical value below the saturation voltage—a behaviour which is explained as due to the absence of space charge. In gas-filled cells the fluctuations increase with increasing anode voltage more rapidly than the photoelectric current, attaining values as large as 4 to 50 times the theoretical, according to the nature of the gas filling. In addition, the fluctuations show an increase as the frequency is decreased. Other things being equal, therefore, it is more advantageous under these conditions to use a vacuum cell with an extra stage of amplification. [For Part I see Abstract 316 (1933).] L. A. W.

4288. Photoelectric Reading Machines. G. Schutkowski. *Zeits. f. techn. Physik*, 14. 4. *pp.* 158–160, 1933.—Describes machines based upon " optical congruence." In this method the chosen type is printed on a sheet or on a film, and an optical image of one of the letters to be read is projected upon the sheet. When it happens to fall upon the same letter, there is optical congruence, and the fact is announced by a relay which either sounds the letter or picks out the corresponding type in a blind alphabet. E E. F. d'A.

See also Abstracts 4013, 4210, 4220, 4225, 4247, 4257, 4295.

PIEZOELECTRICITY.

4289. Piezoelectric Resonator with Uniform Response for a Given Range of Frequencies. A. Guerbilsky. *Comptes Rendus*, 196. *pp.* 1871–1873, *June* 19, 1933.—In order to get a wide range of response quartz plates of non-uniform thickness are employed. Such plates may have a resonance curve with the central part approximately horizontal for a considerable range on either side of the mean frequency. They have been utilised for the production of electro-optical relays for sound recording and of piezoelectric microphones. Electro-optical relays working with polarised light were made of plates of different dimensions and gave sensibly uniform response for modulation frequencies above 16,000 per sec. [See following Abstract.] A. W.

4290. Piezoelectric Dynamometers of the Resonance Type. A. Guerbilsky. *Comptes Rendus*, 197. *pp.* 399–401, *July* 31, 1933.—An arrangement analogous to that previously employed for the production of piezoelectric microphones [see preceding Abstract] was used. A crystal of suitable frequency was mounted between two electrodes connected in parallel with the condenser of a tuned circuit energised from a separate valve generator at a considerable distance. When the crystal vibrates in resonance it absorbs a large part of the current in its circuit and the pointer of an ammeter connected in series with the condenser falls nearly to zero. When pressure is exerted on the crystal, thus introducing damping, the amplitude of the vibrations decreases and the ammeter indicates corresponding increases of main circuit current. The apparatus may have many different sensitivities since the law of variation of the current as a function of the applied pressure varies with the power of the generator employed. It has thus been found possible to obtain measurements of pressures ranging from a few dozen gm. to several kg. A. W.

4291. Vibrations of a Parallelepiped of Quartz. A. de Gramont. *Comptes Rendus,* 197. *pp.* 101–103, *July* 10, 1933.—A discussion of the function fm, f denoting the fundamental frequency of vibration of a quartz crystal of dimensions e, o and m, e and o being measured parallel to the electric and optic axes respectively. For large values of m/o the product fm is constant, but decreases as m/o is decreased below the value 2. Instability occurs in a region about $m/o=0\cdot5$ and rotational motion of the crystal can be set up which is shown to be due to the induced electrostatic charges and not to an aerodynamical cause. G. G. S.

4292. Vibrating Quartz Crystals and their Sound Emission. K. Bücks and H. Müller. *Zeits. f. Physik,* 84. 1–2. *pp.* 75–86, *July* 17, 1933.—An account of the use of heated wires for supersonic sound measurements. The half wave-length of the standing wave system set up between the face of a vibrating quartz crystal and a parallel reflector is measured accurately by means of such wires. The velocity distribution in front of the crystal face can be found by measurements with very short wires on the progressive wave from the face. A method of making the pressure nodes of a standing wave system visible with the help of alcohol is also given. The amplitudes of vibration and the form assumed by the faces of various quartz oscillators are studied microscopically. G. G. S.

See also Abstract 3957.

THERMIONICS.

4293. Emission from Oxide-Coated Kathodes. Parts I and II. M. Benjamin and H. P. Rooksby. *Phil. Mag.* 15. *pp.* 810–829, *April, and* 16. *pp.* 519–525, *Aug.*, 1933.—It is shown, by X-ray analysis, that the only material present in bulk form in the coating of an active kathode is the monoxide. If the coating consists of a mixture of barium and strontium oxides, these form a solid solution. If the coating is of one oxide only and the emission is destroyed by flashing, the remaining coating can be fully reactivated by repeating the activating process. Recovery of the original activity is not possible after severe flashing of a mixed BaO/SrO coated kathode. If the emission of a kathode coated with a single oxide has been poisoned by oxygen, it may always be completely restored by first flashing at a sufficiently high temperature with space current followed by reactivation. In the case of a mixed BaO/SrO coated kathode it is not always possible to recover the emission in this way. Recovery, however, is possible in this case also if, instead of flashing, the surface layer is sputtered off by ions of argon or mercury. In Part II it is shown that (1) the constituent oxides can exist in all states ranging from a simple mixture to a homogeneous solid solution, and (2) there exists a definite relationship between the physical state of the oxides and the thermionic emission obtained from them. J. S. G. T.

4294. Action of Mercury Metastable Atoms on a Tungsten Surface. S. Sonkin. *Phys. Rev.* 43. *pp.* 788–803, *May* 15, 1933.—The electron emission from metal surfaces due to the action of the 2^3P_0 metastable atoms produced by electron impact was studied. The sensitivity of any metal surface was found to vary with the vacuum in the discharge tube and the extent to which the surface had been cleaned and outgassed. After thorough outgassing and cleaning, each of the metals tested acquired practically the same sensitivity which remained constant over long periods.

Heating of a surface after it had acquired this "normal" sensitivity always resulted in temporary changes of the sensitivity after which it returned to its normal value. This normal value was due to the establishment of a very stable complex arrangement of mercury and oxygen atoms upon the tungsten. Transient values of the sensitivity 50 to 100 times larger than the normal value were observed when the relative concentrations of oxygen and mercury atoms were such as to make possible the formation of monatomic films. From the values of these high sensitivities it appears that in the case of the normal surface not more than 1 or 2 metastable atoms out of 100 caused the emission of an electron. The formation of the sensitive surface was found to be uninfluenced by the metastable atoms. No correlation was found between the changes of response of a surface to mercury metastable atoms and to the radiation from an external source. F. C. C.

4295. Thermionic and Photoelectric Emission of Cæsium-Cæsium Oxide Kathodes as Influenced by Incorporation of Cæsium Atoms in the Dielectric. J. H. de Boer and M. C. Teves. *Zeits. f. Physik*, 83. 7–8. *pp.* 521–533, *June* 28, 1933.—Experiments are described which show that of two similar cæsium-cæsium oxide kathodes, the one in which cæsium atoms are incorporated in the oxide layer gives both higher thermionic and higher photoelectric emission than the other. The time variations of the thermionic and photoelectric emissions from the two kathodes during processing, follow closely similar curves. The saturation current is obtained at a lower potential with the kathode containing incorporated cæsium atoms. The paper also gives a discussion of the mechanism of emission from various types of kathode: layer of electropositive atoms on a metal base, oxide (dielectric) layer with atoms absorbed on the surface, oxide layer with absorbed atoms and with alkali atoms incorporated in the dielectric. W. S. S.

4296. Electron-Microscopic Observations on the Barium Vapour-Deposited Kathode. E. Brüche and H. Johannson. *Zeits. f. Physik*, 84. 1–2. *pp.* 56–58, *July* 17, 1933.—Emission images of a thermionic kathode formed by deposition of barium vapour on a nickel surface were obtained using the electron microscope [see Abstracts 806, 807 (1933)]. On first heating to red heat, the emission was limited to the system of lines forming the boundaries of the coarse crystals of the nickel base and to a system of scratched lines (these were made before deposition of the barium vapour). After a short period of heating, the emission picture changed completely. The scratched lines and the main surface now emitted uniformly, but the system of crystal boundaries appeared as broad ribands in which the emission was nil. W. S. S.

4297. Emission of Metallic Ions from Oxide Surfaces. Part I. Identification of Ions by Mobility Measurement. L. Brata. *Roy. Soc., Proc.* 141. *pp.* 454–462, *Aug.* 1, 1933.—A method of producing sources of positive ions of thallium, indium and gallium is described. The ions are identified by determining their mobility in nitrogen gas. In this gas it is shown that the mobility of an ion gives an unambiguous measure of its mass. The mobility method therefore offers a means of determining the mass of positive ions in a gas at high pressures. The mobility K of any positive ion of mass M in nitrogen gas of molecular weight m at 17° C. is given by the equation $K=\frac{0\cdot48}{\sqrt{\rho(D-1)}}\cdot\left(1+\frac{m}{M}\right)^{\frac{1}{2}}$ cm./sec./unit electrostatic field, where ρ is the density of the gas and D its dielectric constant. The mobility of thallium and indium ions has been determined in helium, neon and argon. [See following Abstract.] AUTHOR.

4298. Emission of Metallic Ions from Oxide Surfaces. Part II. Mechanism of Emission. C. F. Powell and L. Brata. *Roy. Soc., Proc.* 141. *pp.* 463–472, *Aug.* 1, 1933.—An apparatus is described which allows a known number of thallium, indium, or gallium ions to be deposited on to an iron oxide surface. When the oxide is heated a large proportion, possibly 100 %, of the deposited atoms are re-evaporated as ions. The number of ions leaving the iron oxide surface corresponds in some experiments to the deposition on the superficial area of the oxide of a layer 1000 atoms thick. These atoms must actually have been distributed as a monatomic layer over the large surface presented by the microcrystals composing the source. If the oxide is heated above about 800° C. it sinters and the original properties of the surface are destroyed. With a given metal on the surface the maximum positive ion current is limited by this maximum available temperature and by the positive ion work function. The failure of the gallium sources in the work described [see preceding Abstract] is thus explained. The experiments suggest an explanation of the characteristics of the positive ion emission from Kunsman sources and of its catalytic activity in the synthesis of ammonia. AUTHORS.

See also Abstracts 4217, 4218, 4219, 4220, 4221, 4222, 4223, 4287.

THERMOELECTRICITY.

4299. Thermoelectric and Volta Potentials of Cuprous Oxide. G. Mönch and S. Stechhöfer. *Zeits. f. Physik,* 84. 1–2. *pp.* 59–65, *July* 17, 1933.—At the two unequally heated ends of an insulated polycrystalline piece of Cu_2O a p.d. was measured of 0·5 volt for a temperature difference of 100° C. This p.d. was established by static measurements of tension between two metal plates which were placed opposite the ends of the piece of Cu_2O and were connected with them through an ionised portion of gas. The ionisation was due to a radioactive preparation. The measured potential difference is the sum of two effects, the thermoelectric force and the Volta p.d. The two magnitudes are calculated at 0·1 and 0·38 volt, together being 0·48 volt for a difference of temperature of 100° C. The measurement is in agreement with the calculation of 0·5 volt for this temperature difference. J. J. S.

4300. Transportation Heats in Electrolytic Peltier Heats. E. Lange and T. Hesse. *Zeits. f. Elektrochem.* 39. *pp.* 374–384, *June,* 1933.—The existence of transportation heats in electrolytic Peltier heats can be clearly established. On the characteristics of these magnitudes it may so far be said that their dependence on concentration and activity seems to be rather slight, besides they appear to stand in a certain provisionally purely empirical relation to the transportation numbers of the ions concerned. The magnitude may already be estimated to a first approximation and amounts to about 100 to 3000 cal./mol. J. J. S.

See also Abstracts 4149, 4211, 4212, 4213, 4214.